Chapter 2 of TAN SAR ✓
INEL-94/0163

2. FACILITY DESCRIPTION

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2. FACILITY DESCRIPTION

Test Area North (TAN) is the northernmost developed area within the Idaho National Engineering and Environmental Laboratory (INEEL). It was originally established to support the Aircraft Nuclear Propulsion Program, which operated from 1951 to 1961. Since 1961, TAN buildings have been adapted for use by various other programs, such as Test Area North Operations (TANO). This safety analysis report (SAR) addresses only the buildings and areas within TAN that are managed by TANO.

The mission of TANO is to safely examine, test, and monitor spent nuclear fuel, storage casks, and radioactive materials as deemed necessary by the U.S. Department of Energy (DOE). TANO also provides interim storage for these items for the program's duration and while these items await final storage disposition by DOE.

The general design of the principal structures, systems, and components that are managed by TANO are described in this chapter. This description is consistent with TANO's mission and Hazard Category 2 classification.

2.1 Requirements

The following Codes of Federal Regulations (CFRs), DOE orders, and other requirements apply to this chapter. These requirements are implemented as indicated throughout the chapter.

- 10 CFR 72, "Criteria for Spent Fuel, High-Level Radioactive Waste Storage and Handling"
- 10 CFR 830.120, "Quality Assurance"
- 10 CFR 835, "Occupational Radiation Protection"
- DOE Order 420.1, "Facility Safety," October 24, 1996
- DOE-ID Order 414.1A, "Quality Assurance," May 17, 2000
- American National Standards Institute (ANSI) 14.5, "American National Standard Code for Leak Testing"
- ANSI B31.3, "American National Standard Code for Pressure Piping"
- American Concrete Institute (ACI) 349, "Code Requirements for Nuclear Safety Related Concrete Structures"
- American Society of Mechanical Engineers Boiler and Pressure Vessel Code
- American Welding Society (AWS) D1.1, D1.2, or D1.4, "Structural Welding Code ASME Code."

2.2 Facility Overview

There are approximately 31 major buildings, plus support structures such as power, water, and disposal installations, located within the boundaries of TAN. Figure 2-1 shows the area of TAN that contains the buildings and structures managed by TANO. The nuclear buildings and structures that are discussed in this chapter and analyzed in Chapter 3 are as follows:

- TAN-607. The layout of TAN-607 and attached buildings (TAN-608, TAN-633, TAN-649, and TAN-668) is shown in Figure 2-2. For the purposes of this safety analysis, the areas within TAN-607 are referred to as separate entities, as follows: (a) TAN Hot Shop, which includes TAN-668, Heavy Equipment Cleaning Facility (HECF), and the special equipment services (SES) room; (b) TAN Hot Cell; (c) TAN Storage Pool, which includes TAN-608, Water Filtration Building, and TAN-649, Water Filtration Building; (d) Hot Cell Annex (HCA) (TAN-633); and (e) TAN Warm Shop. The TAN exhaust stack (TAN-734) is addressed in the accident analysis for all stack release scenarios. (TAN-607A area is excluded from this SAR.[1])

- TAN-616. The Liquid Waste Treatment Facility, which includes three tanks (V-1, V-2, and V-3) that are collectively referred to as TAN-1703.

- Radioactive Parts Service and Storage Area (RPSSA). This area includes two storage buildings (TAN-647 and TAN-648) and two concrete storage pads.

- TAN-666. The Radioactive Liquid Waste Storage and Transfer Building.

- TAN-790. The Three-Mile Island (TMI)-2 Abnormal Waste Storage Pad.

- TAN-791. The Spent Fuel Storage Cask Testing Pad.

Nonnuclear buildings and structures under TANO management are the office areas in TAN-607, TAN-615, TAN-618, and TAN-662. TAN-615, Assembly and Maintenance Building, is used for maintenance work. TAN-618, Pad Data Collection Building, houses the equipment needed to monitor the casks on the storage pads. TAN-662, Gas Cylinder Storage, is used to store gas cylinders needed to support TANO activities.

Additional facilities associated with this SAR include:

- TAN-634 (Exhaust Stack/Diesel Generator)
- TAN-720 (RPSSA Concrete Storage Cask)
- TAN-721 (RPSSA Heat Removal Storage Cask)
- TAN-742 (Liquid Waste Holding Tanks)
- TAN-743 (Associated with TAN-662)
- TAN-770 (Liquid Nitrogen Tank)

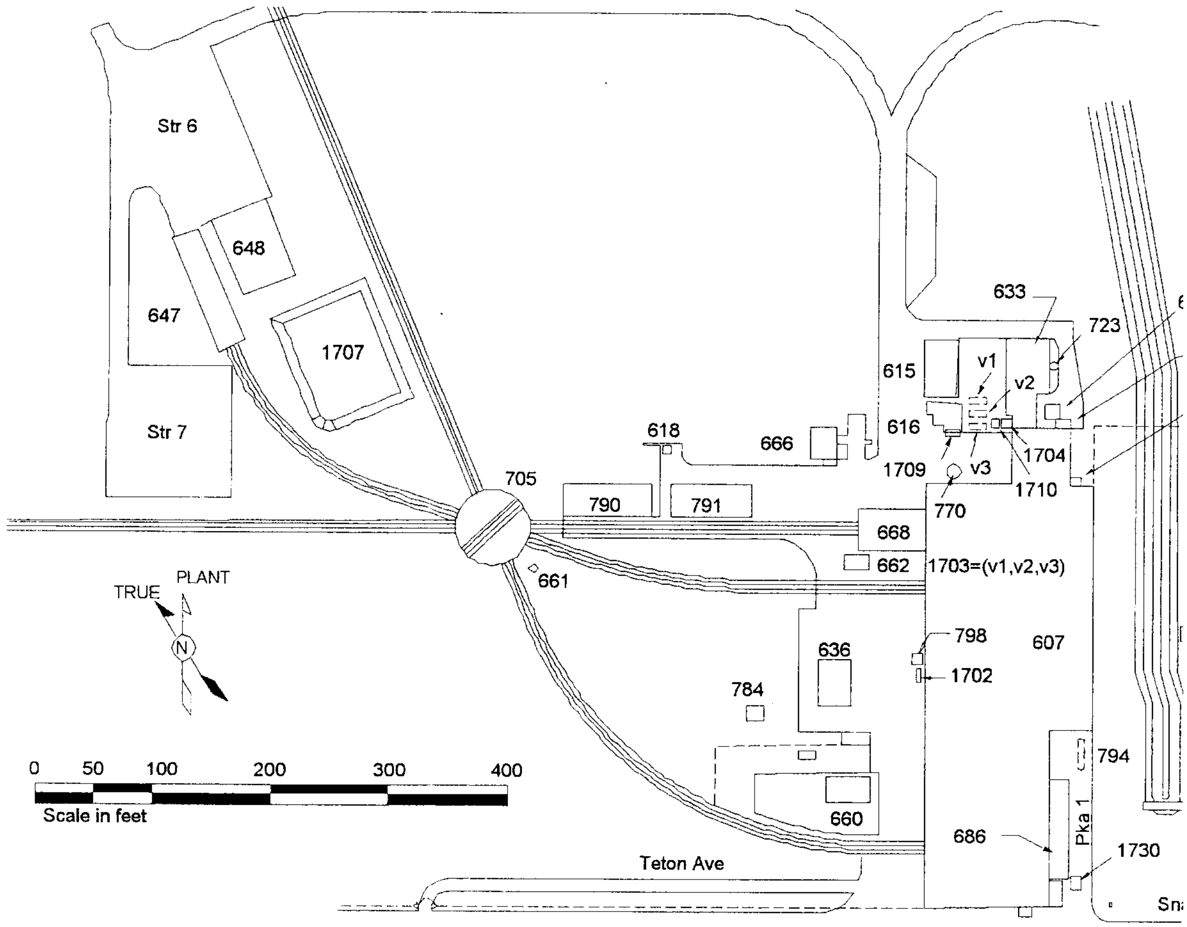


Figure 2-1. Vicinity of TAN in which TANO is located.

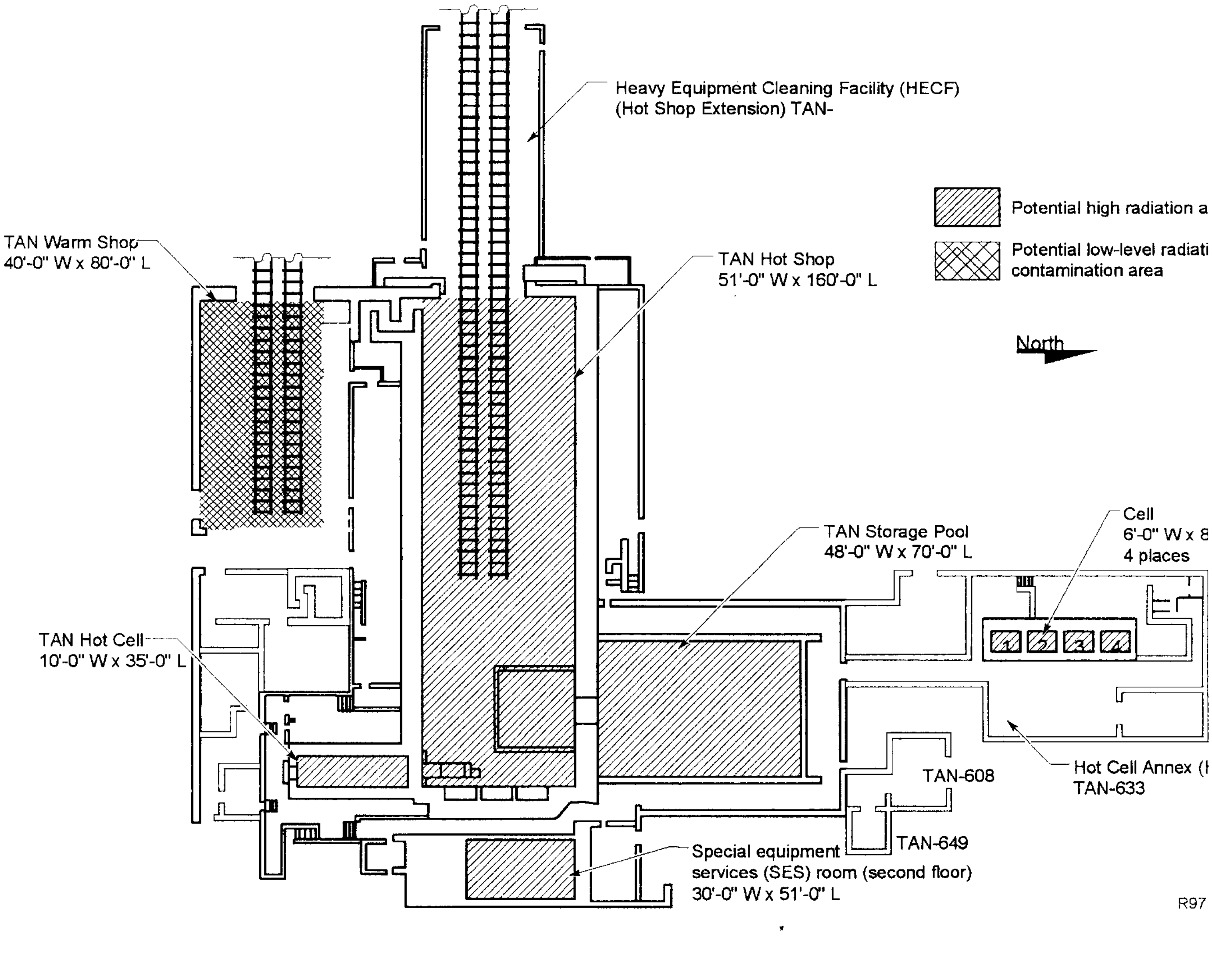


Figure 2-2. Layout of TAN-607 and attached buildings.

- TAN-1709 (Caustic Tank in TAN-616)
- TAN-1710 (Sand Tank at TAN-616)
- TAN-1729 (Dry Cask Storage Pad)
- TAN-1734 (Emergency Generator Fuel Tank).

2.3 Facility Structure

As indicated in Section 2.2, the TANO facility consists of many areas that are significantly interrelated and some areas that are not. The interrelated areas are located in TAN-607. This section addresses these areas of TAN-607 (TAN Hot Shop, TAN Hot Cell, TAN Storage Pool, HCA, and TAN Warm Shop) as single entities. The other buildings listed in Section 2.2 are also discussed following the subsections concerning the areas in TAN-607.

2.3.1 TAN Hot Shop

The TAN Hot Shop is a large, shielded high bay with overhead cranes, a large overhead manipulator, auxiliary wall-mounted manipulators, and other equipment for remote handling of radioactive material. A floor plan and sectional view are shown in Figure 2-3.

The walls and ceiling are constructed of ordinary concrete. The walls are 6 ft 10 in. thick up to the lower ledge. Between the lower ledge and upper ledge, the thickness is reduced to 6 ft 8 in. Between the upper ledge and the roof, the walls taper from a thickness of 4 ft 4 in. to 2 ft. The ledges provide support for the overhead crane and manipulator tracks.

The roof is nominally 1-ft-thick concrete supported by trusses that span the Hot Shop on 18-ft centers. The concrete floor is supported on beams and is designed to support a 250-lb/ft^2 load distributed uniformly over the entire area.[2-2] An 18 × 93-ft section of the floor, encompassing the double railroad tracks, is reinforced to support extremely heavy loads; for example, the shielded locomotive (215 tons)[2-1], cask transporter (up to 195 tons),[2-3] and heavy transport truck (up to 100 tons).[2-4] The other areas of the Hot Shop floor are also capable of supporting concentrated loads, but more care must be taken in placing the load to ensure adequate support. The floor system is made up of vertical piers, horizontal load-supporting grade beams, and the 1-ft-thick reinforced concrete floor slab. Each individual pier under the floor can support a load of approximately 75 tons,[2-5] and the grade beams are proportionally sized. This feature allows large casks and other heavy items to be located off of the reinforced railroad track when specifically analyzed, with their weight properly positioned and distributed. The capacity of the floor over the utility tunnels is less than other areas because of the wider spacing of piers and beams. Use of the spent nuclear fuel cask transporter in the TAN Hot Shop and placement of heavy loads is administratively restricted to the areas and locations specifically shown to be acceptable (Figure 2-4).

The west wall of the Hot Shop has a 28-ft-wide × 33-ft-high doorway that is used as a truck and locomotive entrance. Rail tracks enter through this doorway and extend 90 ft into the Hot Shop.[2-1] The west biparting doors are controlled from the south gallery. Limit switches and controls decrease door speed as the two sections approach fully open or fully closed positions. There is a "door open" indicator light on the control console.

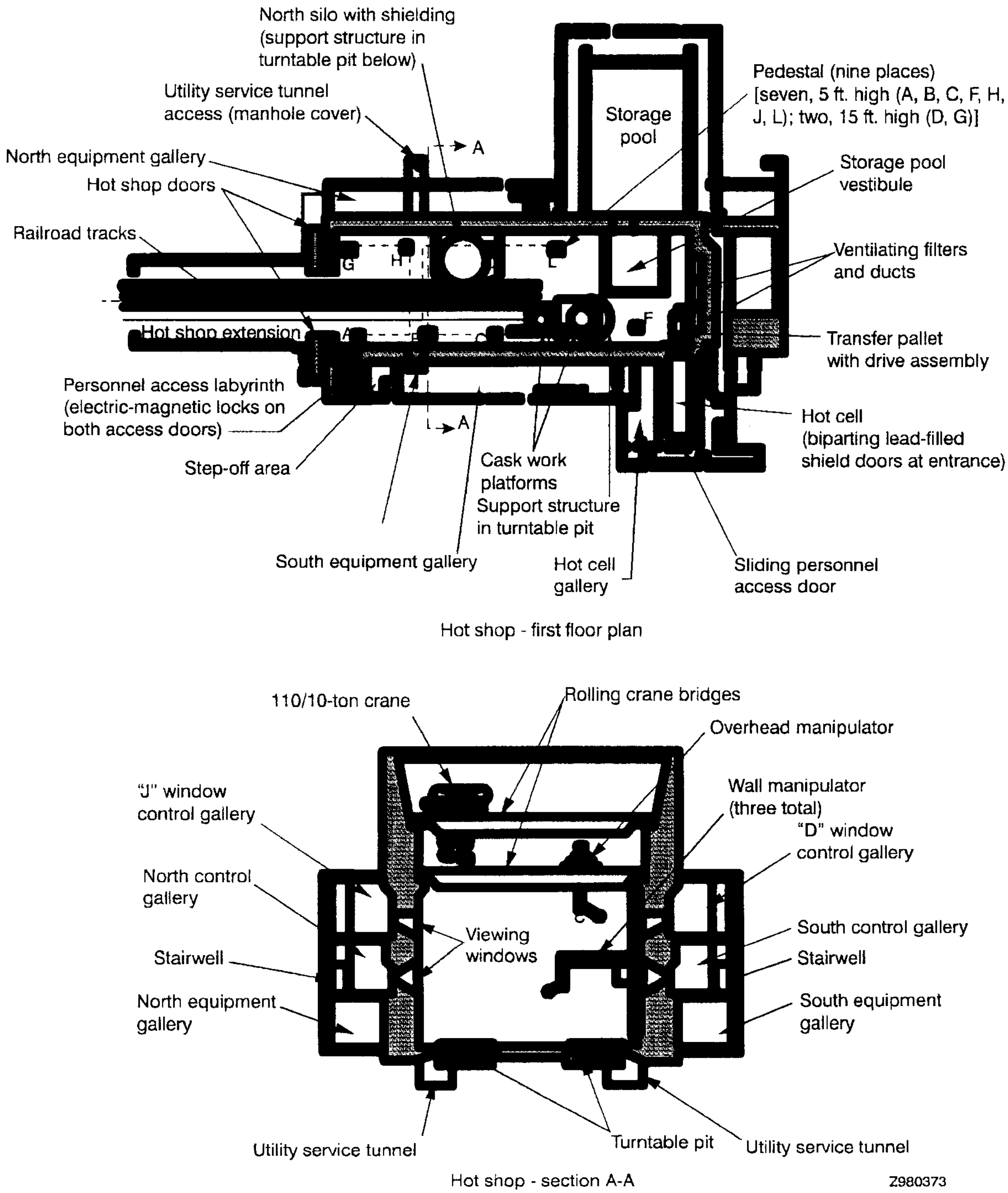


Figure 2-3. TAN Hot Shop floor plan and sectional view.

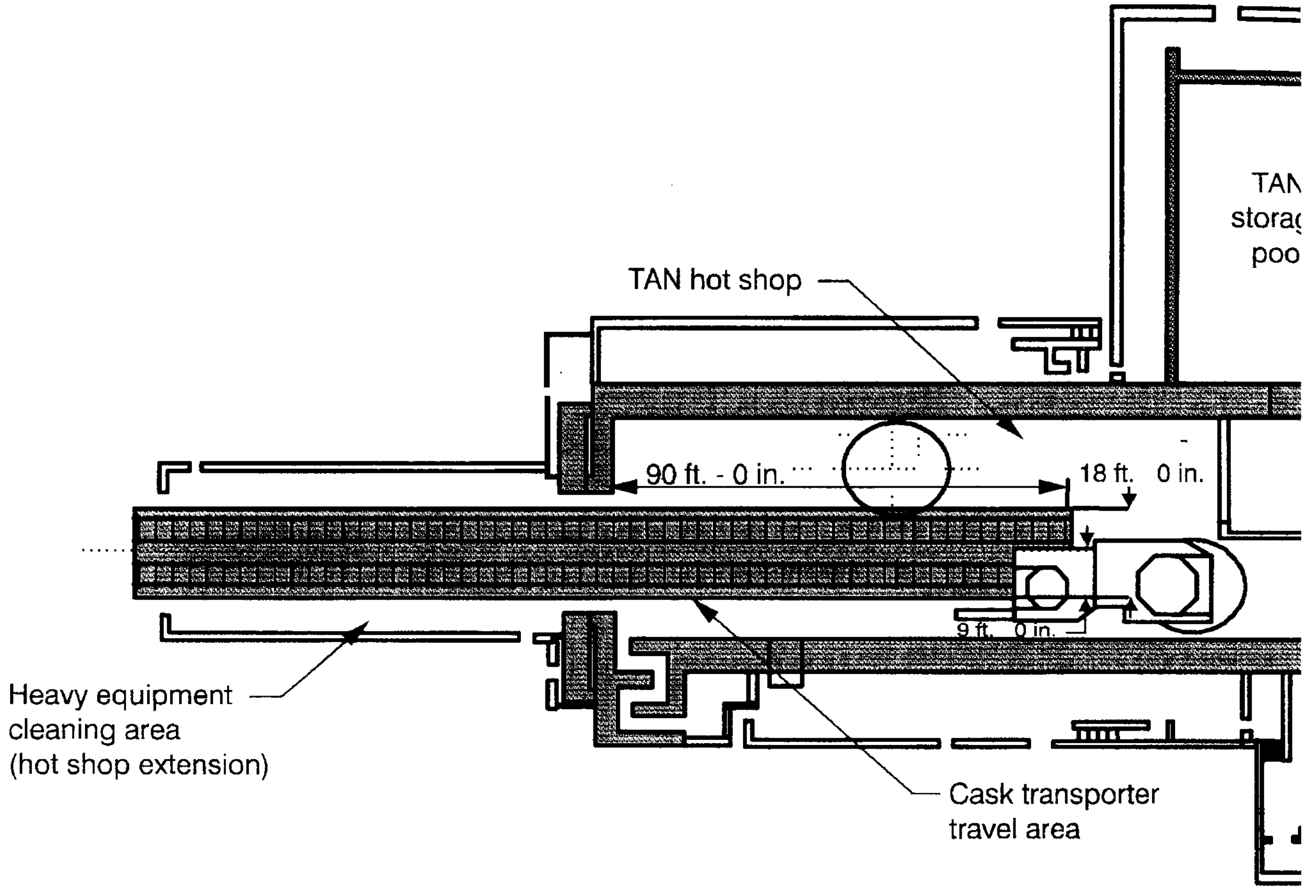


Figure 2-4. TAN Hot Shop transporter travel area.

Personnel enter through a shielded labyrinth located on the ground-floor level at the southwest corner of the Hot Shop. Access doors at each end of the labyrinth are interlocked electronically and must be unlocked from the master console or shift supervisor's office. Change room facilities (Room 115B) are located just outside the monitoring room (Room 103).

Shielded operating galleries are located at two elevations outside the north and south walls of the TAN Hot Shop. These galleries constitute the control areas for remote operations in the Hot Shop; the operations are viewed through shielding windows. The following trouble indicators and alarms are located at the master control console located at the west end of the south operating gallery:

- TAN Storage Pool low water level alarm
- Low-pressure breathing air indicator
- High-temperature breathing air indicator
- High and low exhaust fan differential pressure indicators (an indication of filter plugging or leaking)
- Low flow alarms for E7, E7A, and E8 (exhaust fans)
- Fans E7 and E7A running alarm to mitigate both fans operating at the same time
- Tunnel high water level alarm indicator.

Twelve ports for shielding windows are built at different elevations into the north and south TAN Hot Shop walls (see Figure 2-5). Nine of these ports contain windows and three contain high-density concrete shield plugs. These windows, originally built in 1954, are combination-type shielding windows containing mineral oil, zinc bromide, and leaded glass. One window contains demineralized water instead of zinc bromide. The zinc-bromide solution is contained in a carbon steel "tank" (with two glass and four steel sides), which also serves as a frame for the windows. Numerous layers of paint protect the steel from the zinc bromide. Thermal expansion of the zinc bromide is permitted by an expansion area at the top of each window.

The windows are flush with the walls on the hot side and sealed into the walls with high-density concrete grout. Steel shot occupies the space between the frames and the windows to prevent any radiation from streaming through the voids. All penetrations through the wall around each window are shielded with steel shot and closed off at each end when a port is not being used. Those penetrations that are used to pass various cables from the operating gallery into the Hot Shop are backfilled with steel or lead shot held in place by steel or lead wool according to TAN requirements.[2-6] These requirements ensure that if any penetrations are modified they are properly backfilled to ensure that the Hot Shop will remain well-shielded from an inadvertent criticality accident.[2-7]

The windows are cold-side loaded, which means that they can be extracted or removed from the operator's side. One case where this will happen is when the windows are being refurbished because of a lack of visibility. The chemical reaction of ZnBr and the carbon steel tank, caused by the deterioration of the protective paint on the tank, will cause a precipitate to form which reduces window visibility. When the window is refurbished, the windows will be purged with nitrogen to reduce corrosion, the window frame will be repainted, the ZnBr will be filtered to remove precipitates, the glass panes will be cleaned, and the window will be returned to its original state.

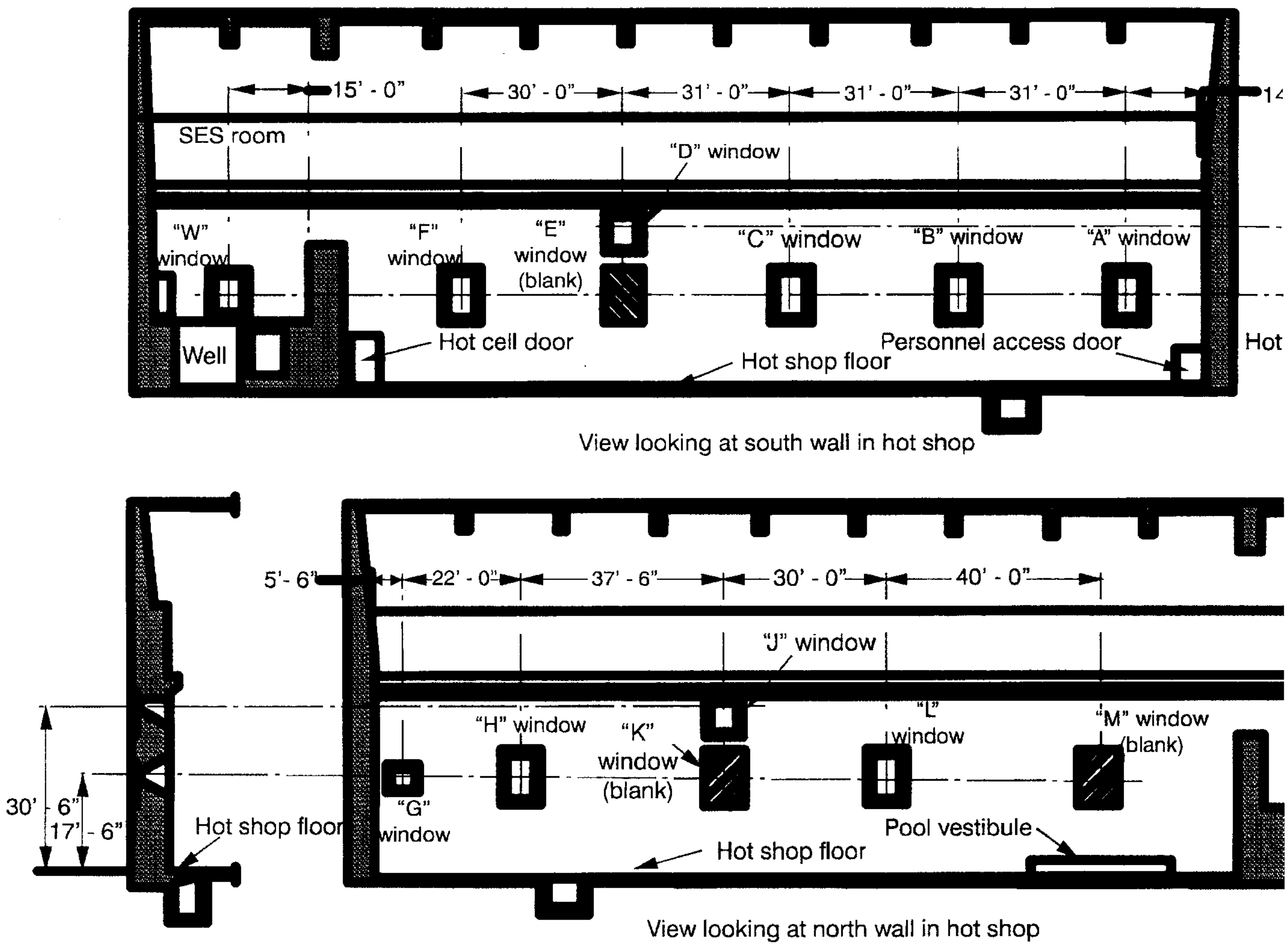


Figure 2-5. Elevation view of the TAN Shot Shop shielding windows.

Three types of glass are used in the shielding windows. White-water lime glass is used for scratch resistance, and two high density glasses that contain lead are used. Type A high density glass has a density of 167 lbm/ft^3, and Type B glass has a density of 204 lbm/ft^3.[2-8] There are four types of windows (number 2 through 5) used in the TANO Hot Shop. Each is composed of layers of glass, air, and zinc-bromide; all are 5 ft 10 in. thick. Window Types 2, 3, and 5 have the following arrangement[2-8]: . . . .

- White-water lime glass, for protection from scratching
- Type B glass, 3-13/16 in. thick
- Type A glass, 4-1/16 in. thick
- Zinc-bromide solution, 4 ft thick, specific gravity of 2.5
- Type A glass, 4-1/16 in. thick
- Type B glass, 4-7/16 in. thick
- Type A glass, 3-13/16 in. thick
- Dead air space, 1/2 in. thick
- Type A glass, 1/2 in. thick. (This plate of glass has been added to each window at a 17.5-ft elevation to act as a storm window. This thermal barrier protects the window from potentially damaging thermal stresses when it is exposed to sudden temperature changes caused by opening the TAN Hot Shop doors during winter months.).

The Type 4 window configuration is as follows:[2-8]

- Type A glass, 4-1/16 in. thick
- Zinc bromide, 5-1/2 in. thick
- Type A glass, 4-1/16 in. thick
- Dead air space, 1/2 in. thick
- Type A glass, 1/2 in. thick.

The zinc-bromide capacities for each window type are:[2-5]

Type 2: Windows A, B, C, F, H, and L, capacity = 750 gal

Type 3: Windows D and J, capacity = 500 gal

Type 4: Window W, capacity = 750 gal

Type 5: Window G, capacity = 500 gal (the zinc bromide in this window has been replaced with demineralized water)

Blank: Window E in the south gallery, and windows K and M in the north gallery.

The shielding capacity of window G is less than the other shielding windows, because the shielding capability of demineralized water is less than that of zinc bromide. However, adequate attenuation is still provided by this window.[2-8] Also, the physical construction of the TAN Hot Shop prevents fuel bundles and other high radiation sources from being moved within 3 ft of window G.

2.3.1.1 Special Equipment Service Room

The SES room is an extension on the east end of the TAN Hot Shop, separated from the Hot Shop by a set of large shielding doors. The finished floor elevation of the SES room is 13 ft above the Hot Shop floor, and a 5-ft-thick concrete parapet rises 13 ft above the SES room floor.[2-8]

A set of 5-ft-thick biparting concrete shield doors, normally located in recesses in the north-south walls, rides on rollers across the parapet to isolate the SES room from the Hot Shop.[2-8] These doors extend from the parapet to the roof. The rails for the bridge crane and the overhead manipulator are hinged, and swing out of the way when the doors are closed. Controls for opening and closing the doors are located in the SES room operating gallery, an extension of the Hot Shop south operating gallery. The SES room operating gallery has been shown to be well-shielded from an inadvertent criticality for TMI-2 canisters (see Addendum 1).

The 3-ft-thick concrete slab that forms the floor of the SES room also covers a personnel access tunnel connecting the equipment and work areas on each side of the TAN Hot Shop. A 13-ft-deep service pit, approximately 12 ft wide and 15 ft long, extends through the floor slab down to the Hot Shop floor level. This pit contains a high-efficiency particulate air (HEPA) filter bank used for exhausting the SES room by way of the E7 and E7A fan system. A viewing window is located in the south wall just above a remote control station.

Personnel enter the SES room through a manually operated, rolling shield door that opens from the operator gallery.

2.3.1.2 Heavy Equipment Cleaning Facility

The HECF is insulated, heated, and weather-tight. It provides a waiting area for trucks and components scheduled to enter the TAN Hot Shop. The HECF measures approximately 70 × 40 ft, with an eave height of 40 ft. A vehicle door at the west end offers clearance identical to the Hot Shop doors, with a measurement of 28 × 33 ft. The entire facility provides a weather break to allow the Hot Shop doors to be open during inclement weather conditions.

A high-pressure cleaning unit is available to wash heavy equipment and cask assemblies. This unit is also used to de-ice heavy equipment during the winter. Water from this system drains to TAN-711, Sanitary Treatment Plant. A snorkel system in the facility vents vehicle exhaust to the outside.

2.3.1.3 110/10-Ton Overhead Crane

The 110/10-ton overhead crane is the major lifting device for handling spent nuclear fuel, casks, and other heavy equipment in the TAN Hot Shop. The 110/10-ton crane bridge runs on 100-lb building rails mounted on the upper ledges of the TAN Hot Shop and SES room walls. The rails, which are 195 ft long, run the full length of the Hot Shop and SES room. The rails are hinged at the entrance to the SES room and swing out to allow the SES room shielding doors to close, and are interlocked to prevent crane operations over open rails.

The 110/10-ton overhead crane is a radio-controlled unit and consists of a bridge spanning the full width of the TAN Hot Shop, a trolley mounted on the bridge, and two hoists mounted on that trolley. The larger hoist is rated for 110 tons and the other is rated for 10 tons. Both the 110- and 10-ton hooks are continuously free-swiveling and are designed for use underwater in the Storage Pool vestibule. The 110/10-ton crane hooks and emergency-load-release mechanisms have been designed for remote operation.

From a 200-A breaker at Motor Control Center #2, commercial or standby 480-V three-phase power is supplied to the 110/10-ton overhead crane through bus bars and collectors along the south wall of the TAN Hot Shop. The alternating current voltage is then rectified and controlled through the primary or secondary control panels located on the east walkway of the bridge.

2.3.1.4 Overhead Manipulator

The overhead manipulator (O-man) is a heavy duty, bridge and trolley mounted, remote electromechanical manipulator. A set of rails mounted on a wall ledge below the 110/10-ton overhead crane carries the manipulator bridge the full length of the TAN Hot Shop and SES room. Bridge rails, supporting a trolley, carry the O-man the full width of the shop. Trolley and bridge speed is variable up to 50 and 100 ft/min, respectively.

The O-man is capable of handling a 500-lb load. It can grasp and manipulate tools, and has a shoulder hook that can support up to 5,000 lb to a height of approximately 30 ft.[2-2] The O-man is controlled at Hot Shop and SES window control stations. The control stations are electrically interlocked to prevent simultaneous control from more than one station.

2.3.1.5 Wall-Mounted Manipulators

Three wall-mounted, electromechanical manipulators in the TAN Hot Shop are capable of performing tasks throughout most of the Hot Shop, excluding the SES room. The hoist provided for each manipulator is an extending tube crane with an extension of 92 in. At the end of the crane, a heavy-duty gear box acts as a shoulder pivot. A 60-in. extension is attached to the gear box. A shoulder, attached to the end of the extension, rotates a manipulator arm. The shoulder hook is rated for a 150-lb load with the extension tube vertical. The entire manipulator is capable of lifting 150 lb in any position.

The wall-mounted manipulators have a reach as described below:

- Horizontal rotation with respect to the vertical wall—180 degrees
- Elevation/depression with respect to the horizontal—15 degrees below horizontal to 30 degrees above horizontal
- Extension/retraction—boom only, 14 to 20 ft; tube extension unit only, 9.75 to 11.75 ft
- Rotation at boom end—180 degrees with respect to boom centerline
- East-west travel—the track-mounted base can traverse the Hot Shop south wall for approximately 122 ft
- Vertical travel—the entire unit can travel vertically on the carriage approximately 15 ft

- Other motions—the elbow and shoulder have full rotational capability in addition to joint motion.

2.3.1.6 Hot Shop Turntables

The TAN Hot Shop can be equipped with two turntables that rotate large pieces of equipment for inspection and assembly (disassembly) with remote manipulators. The turntables are located in pits along with rails, pivot assemblies, and drive motors. Each turntable can support a 60-ton load over three supporting pads on each side of the turntable. The pads are drilled, tapped, or doweled to accommodate special fixtures used for supporting and holding the load.

2.3.1.7 North Silo

The TAN Hot Shop North Silo provides storage for dry spent nuclear fuel elements and lead test assembly tritium producing burnable absorber rods (TPBARs). See Section 2.4.1.3 for a detailed description of TPBARs.. It consists of a shielded lid and two concentric upright steel cylinders placed over and around the north turntable pit. The turntable, rails, pivot assembly, and drive motor have been removed from the north turntable pit and replaced by a load-spreading device of criss-crossed, 14 in.-wide flange carbon steel beams.

The outer wall is 0.25 in. thick and the inner wall is 0.5 in. thick. The 6-in. annulus between the two concentric upright steel cylinders is filled with lead shot, and the lid contains lead slabs on a steel plate between the I-beam supporting structure. The silo has an outside diameter of 20.75 ft, exclusive of the external wall strengthening beams. The inside diameter is 19.7 ft, but vertical beams attached to the inside of the inner silo wall, for structural stability and lid support, reduce the inside clearance to 18.8 ft. Both silo walls are constructed of carbon steel. The silo height is approximately 18.5 ft. The shielded lid is sealed to the silo walls by an inflatable seal, allowing an inert atmosphere to be retained inside the silo.

Canister storage racks located in the two north quadrants of the silo provide fuel element storage. The racks are designed to hold spent nuclear fuel elements in a vertical position with a minimum 16-in. center-to-center spacing. Each rack is a tubular frame with the top, bottom, and center spacing plates. Storage items are contained in sleeves that are open-ended and suspended by flanges from the top spacing plate. The center and bottom plates act as guides for insertion of the sleeves.

Shield plugs have been placed into some peripheral storage positions. The lead-filled shield plugs are made from 8 × 8-in.-square carbon steel tubing with a wall thickness of 0.5 in. and a bottom and top closure plate. The interior space is 13.75 ft height and filled with the same type of lead shot used in the wall. A lifting bail at one end permits the plug to be inserted into the storage rack position with the 110/10-ton overhead crane. The overall weight of each plug is approximately 3,000 lb. Twenty-one of these plugs have been built and installed in the two rack quadrants, leaving 17 positions open for radioactive material storage. Plugs can be installed, relocated, or removed as necessary to provide adequate shielding for specific material loadings.

In addition, two carbon steel shield curtains have been made from 8-ft × 15-ft × 1-in. steel plates attached to triangular frames.[2-8] The frames consist of 3 × 3-in. carbon-steel tubing with a wall thickness of 0.25 in. One curtain has been installed in each of the two south quadrants of the silo such that the steel plates face the northwest and northeast rack quadrants. The frame structures are designed to fit into the existing internal support structure in the same manner as the fuel rack quadrants. Furthermore, shield walls have been added to the outside of the silo.

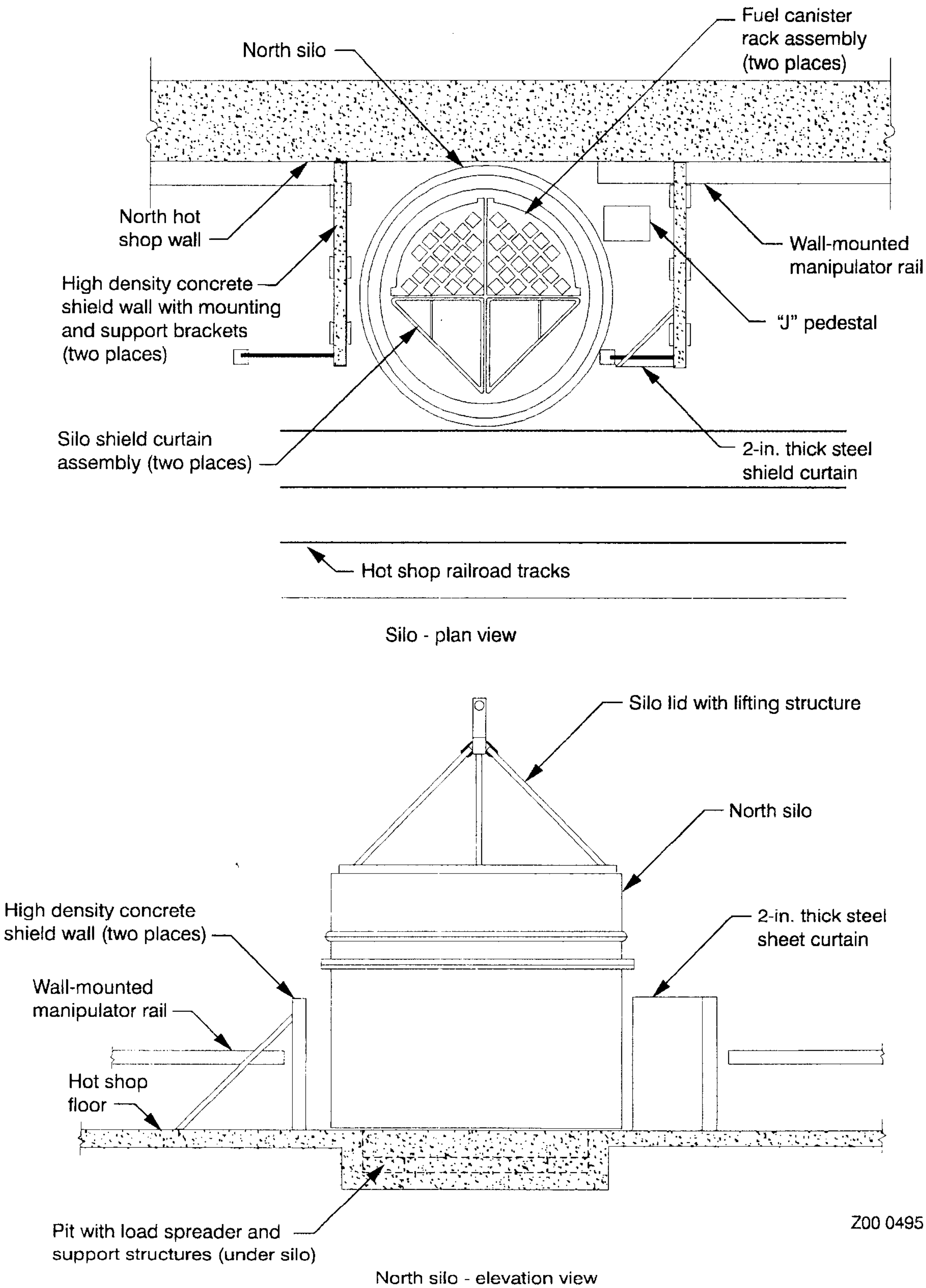


Figure 2-6. North Silo plan and elevation view.

The exterior shield walls consist of two high-density concrete slabs that are approximately 10 ft high, 18 ft long, and 10 in. thick,[2-8] and weighing approximately 16.5 tons each. The exterior shield walls are located along the east and west sides of the silo at right angles to the north wall of the Hot Shop. These walls are anchored to the floor and to the north wall of the Hot Shop, and are braced to the floor at the south end of each wall. Because of interference from other Hot Shop equipment, the west shield wall is approximately 2 ft from the silo wall. The east shield wall is 5.5 ft from the silo wall and encloses pedestal J between it and the silo. It has an additional steel wall attached at a right angle to its south end. This steel wall is 6.2 ft thick and is as tall as the concrete wall. It serves to reduce radiation "shine" through the otherwise large gap between the concrete shield walls and the silo.

A neutron shield wall made of double thickness 2-in. × 4-ft × 8-ft polyethylene slabs can be placed in a flat "V" shape along the south side of the silo or can be removed to allow equipment to move further into the shop. The wall is attached to an angle iron frame for support. Except for a narrow personnel access gap on each end, the wall connects the two concrete shield walls to surround the silo. The apex of the "V" intrudes a few inches into the four-rail track at the south side of the silo. Figure 2-6 shows a plan and elevation view of the silo and its shielding components.

2.3.1.8 Rail System

A four-track, standard gauge railroad system, between the TAN Hot Shop, Contained Test Facility, and other facilities at TAN, extends 90 ft into the Hot Shop through the west biparting shield doors. Flatcar-mounted systems and large equipment were moved into or out of the Hot Shop with a shielded locomotive or a trackmobile available for this purpose. A 90-ft turntable, located just west of the Hot Shop, facilitated maneuvering flatcars between the TAN facilities served by the railroad system.

This system is not currently operational because of maintenance deficiencies. However, it could be put back into service if the required corrective actions were performed.

2.3.1.9 Service Pedestal

Nine floor-mounted service pedestals, one in front of each window, provide one or more of the following services. The pedestals are modified as needed to provide the combination of services required by the process.

- Air—90 psi–Snap–Tite or equivalent, coupling 3/4-in. AVSRN-12
- 120-V/30-amp, three-pole receptacle (one pole for ground)
- 120-V/30-amp, five-pole receptacle (tool power)
- 208-V/30-amp, three-phase, four-pole receptacle
- Demineralized water—1-in. pipe—100 psi (supply and return); 2-in. Snap-Tite and 2-in. Wiggins or equivalent
- Raw water—2-in. pipe, 2-in. Snap-Tite or equivalent connector
- Treated water—2-in. pipe, 2-in. Snap-Tite or equivalent connector
- 120-V/30-amp, industrial-type outlet

- 208-V/30-amp, industrial-type outlet
- 480-V/60-amp, three-phase, industrial-type outlet
- Breathing air—100 psi—0.5-in. Schraeder or equivalent quick connect/disconnect valves.

In addition to the service pedestals, there are ports ranging in size from 2 to 12 in. surrounding each window. These are normally plugged and sealed, but could be used for providing additional services to the TAN Hot Shop. Another 56 normally plugged and sealed ports penetrating the walls between the equipment galleries and the Hot Shop could also be used for bringing in services.

2.3.1.10 Cask Work Platform

A steel scaffold has been constructed to provide a secure work platform for personnel around the tops of various storage and shipping casks in the TAN Hot Shop. This platform is at an elevation of approximately 13 ft above the Hot Shop floor. It is equipped with guardrails, toe boards, and stairs. Two horseshoe-shaped holes at each end of the rectangular platform provide positions for upright casks to be placed. The smaller of the two holes is approximately 7 ft across and is designed to accept shipping casks. The larger hole is approximately 10 ft across and is used for the larger diameter storage casks. Removable sections of platform are installed across the open ends of the horseshoes after a cask has been put in place to provide secure access completely around the cask top. The platform structure may also be used as a temporary storage location for various grapples (and other lifting devices) and tools.

2.3.1.11 Storage Pool Vestibule

The TAN Storage Pool, which is used to store radioactive components, is located adjacent to the north side of the Hot Shop. A submerged passageway under the Hot Shop wall connects the main Storage Pool to a 24 ft wide × 25 ft long × 24 ft deep pool vestibule, located in the northeast corner of the TAN Hot Shop. The underwater passageway is 19 ft high and 24 ft wide, and the top of the passageway under the shield wall is 5 ft underwater to protect the main pool area from radiation sources in the TAN Hot Shop.

The TAN Storage Pool and Storage Pool vestibule are connected by an underwater rail system and pool transfer cart 11 ft wide and 13 ft long, which is powered by an electric, variable-speed winch. Radioactive components can be lowered on to the pool transfer cart with the 110/10-ton overhead crane and transferred between the Storage Pool vestibule and Storage Pool.

In support of the TMI Program, a 1 in. thick steel plate has been installed on the west side of the vestibule floor to prevent pool damage in the unlikely event of a canister drop.

2.3.1.12 TAN Hot Shop/Cell Transporter

The Hot Shop/Cell transporter system is designed to remotely move objects between the Hot Shop and the TAN Hot Cell. It consists of a load-carrying pallet supported on rollers and propelled by a rack and pinion-drive system. It is remotely controlled from a portable plug-in control station at a window in the Hot Cell control gallery. The transporter system is limited to a load of 4,000 lb.

2.3.1.13 TAN Hot Shop Tunnel

A tunnel under the floor of the TAN Hot Shop provides access to all of the service pedestals, turntables, and control wiring and piping. The tunnel is sloped to drain into a sump located at the entrance point. A float switch in the sump activates a ringing bell and a light at the main console if water reaches the top of the sump. A submersible pump located in the sump must be manually activated to transfer water to TAN-666, the Radioactive Liquid Waste Transfer and Storage Building.

2.3.1.14 TMI-2 Canister Dewatering Equipment

The TAN Pool Stabilization Program (TPSP) has been proposed to remove all of the nuclear-fuel-bearing materials currently in the TAN Storage Pool and place them in dry cask storage at another INEEL facility. These materials include the TMI-2 reactor core debris, Loss-of-Fluid Test (LOFT) reactor spent nuclear fuel, and a small amount of commercial reactor spent nuclear fuel owned by DOE. The TMI-2 core debris is contained in 344 specially designed canisters. Before these canisters can be placed in dry storage, their contents must be dewatered to preclude inadvertent criticality and to minimize radiolysis effects.

The TPSP equipment is in place in the TAN Hot Shop to dewater and dry the TMI canisters. The skid mounted dewatering equipment will include the necessary piping/tubing, control valves, holding tank, pump, process system monitoring instruments, and interfacing connections to draw and route water from the canisters to the water processing subsystem. The water processing subsystem contains the filtering and ion exchange columns necessary for the treatment of the canister water. The Heated Vacuum Drying System (HVDS) consists of three subsystems: (a) the vacuum furnace, (b) the vacuum condenser, and (c) the vacuum pump.

2.3.2 TAN Hot Cell

The TAN Hot Cell, located adjacent to the southeast corner of the TAN Hot Shop, is a conventional, shielded, remote-manipulator laboratory used for specialized disassembly, inspection, and examination. The cell floor is 2.75 ft below the Hot Shop floor level. The cell measures 10 × 35 ft, with a ceiling height of 20 ft. The walls are 4 ft thick, and are made of high-density concrete and lined with stainless-steel sheets. The cell is designed for installation of a false floor to elevate equipment as needed. The main floor has drains to carry contaminated liquids used in decontamination operations to TAN-666, the Radioactive Liquid Waste Transfer and Storage Building. Materials are transferred between the Hot Cell and the Hot Shop through a biparting, 4.5 ×8.25-ft, lead-filled shield door by way of the Hot Shop/Cell transporter system (see Subsection 2.3.1.12).

There are five identical viewing windows in the TAN Hot Cell; four in the west wall (N, P, Q, R) and one (S) in the east wall. The shielding provided by the windows is nominally the same as the 4-ft-thick, high-density concrete walls. The windows are designated "Type 1" and have the following design configuration, starting from the cold side[2-8]:

- One pane of Type E white-water lime glass, 1 in. thick
- Two panes of Type D leaded glass, 4-1/16 in. thick
- Ten panes of Type B leaded glass, 4-1/16 in. thick
- One pane of Type A leaded glass, 3 in. thick.

Spaces between the panes of the windows are filled with mineral oil for viewing clarity which means the shielding calculations did not take credit for the oil. The S window is only partially filled with oil which reduces visibility. Voids around the windows are filled with steel shot to shield radiation streaming.

Personnel can enter through a doorway in the south wall of the cell. The 4-ft-thick, high-density concrete shield door, set in a shallow trench, rolls on free rollers that ride on rails in the floor of the trench. An enclosure has been built around this shield door to prevent the spread of contamination when this door is used.

Through the shield wall and above each of the five viewing windows, two ports are provided for mounting hand-operated master-slave manipulators. The ports above the four windows on the west wall are equipped with seven master-slaves. Two master-slaves are provided at the viewing window on the east side of the cell. The Hot Cell has not yet been shown to be well-shielded from an inadvertent criticality and has TSR controls to ensure that an inadvertent criticality is not possible (see TAN SAR Chapter 3).

Two bridge-mounted, electromechanical manipulators span the TAN Hot Cell on the same set of rails. A 2-ton-capacity chain hoist is also provided on each bridge. Bridge travel is limited by switches that are actuated before the bridge reaches the end of the rail. The carriage travels east-west approximately 63 in. from one end stop to the other by riding on rails welded to the top of the bridge beams. The telescoping tube hoist is mounted on and projects beneath the carriage. A manipulator arm and wrist, which can support either a standard manipulator hand or a hook assembly, are attached to the tube hoist.

Three wall periscopes, two of them mounted on the west wall of the Hot Cell and the third on the east wall, permit viewing and photography inside the Hot Cell within a solid angle of 180 degrees, centered about the objective end. A shield plug is mounted behind the joint between the vertical and horizontal arms of the periscope to reduce radiation streaming through the penetration.

2.3.3 TAN Storage Pool

The TAN Storage Pool, which is used for underwater storage of fissile and radioactive materials, is located in TAN-607 adjacent to the north side of the TAN Hot Shop. The primary shielding for these items is the water covering them; thus, the Storage Pool room is not constructed as shielding but shelters the Storage Pool from the environment.

The fissile material consists mostly of spent nuclear fuel assemblies; the majority of the radioactive materials consist of canisters full of TMI-2 core debris. Various storage devices, such as vertical and horizontal spent nuclear fuel racks, nonfuel-bearing component baskets, and six-pack modules, are used to store the items in the Storage Pool. These storage devices are designed for criticality safety and seismic stability.

The east half of the Storage Pool and a portion of the west side is reserved for the storage of core debris from the damaged TMI-2 reactor. The debris is stored in specially designed canisters placed in six-pack modules, which hold a 2×3 array of these canisters. The rest of the TAN Storage Pool is used for storage of nuclear reactor spent fuel consisting of: (a)fuel from the decommissioned LOFT reactor, which is stored in two modified TMI-2 modules;(b) spent nuclear fuel from various research programs sponsored by the U.S. Nuclear Regulatory Commission (NRC) and DOE, which includes partial and complete commercial reactor fuel bundles, and (c) test fuels from reactor tests conducted at other INEEL facilities (loose fuel rods from these fuel elements are stored in a 10 × 10-ft vertical rod storage rack and a modified horizontal rack). In addition to these fuels, some reactor nonfuel-bearing component materials for DOE programs are stored in the pool.

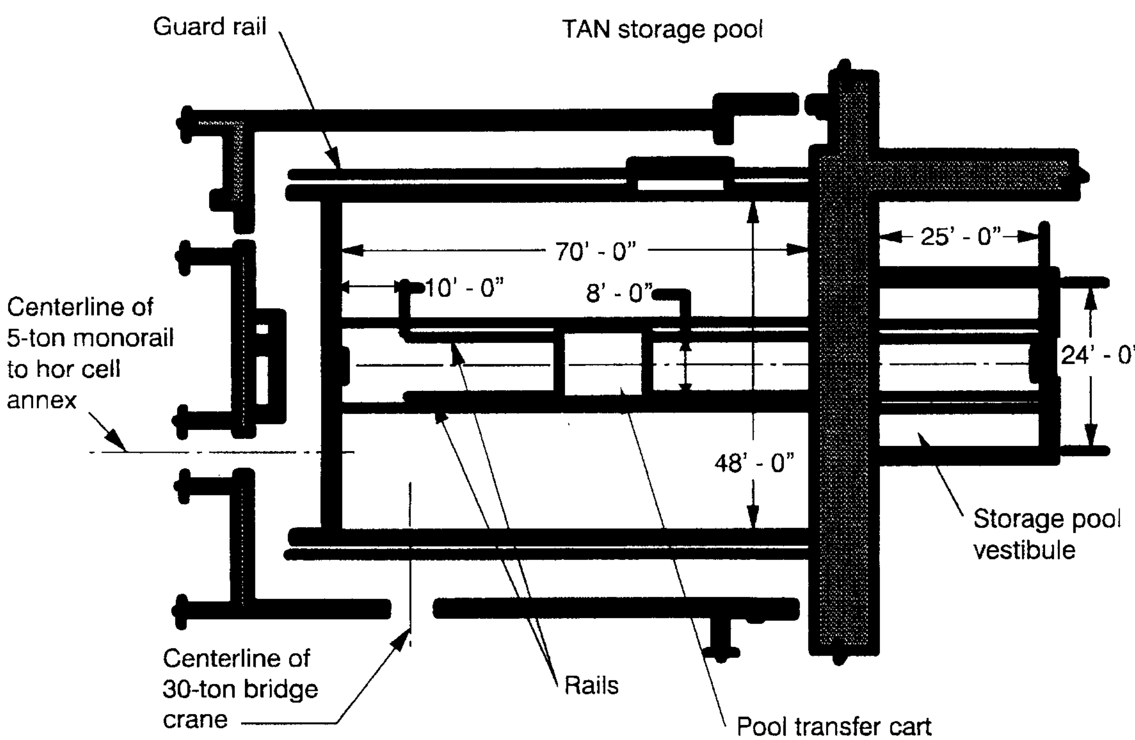
The TAN Storage Pool measures 48 × 70 ft and is 24 ft deep. The Storage Pool is connected to the Storage Pool vestibule in the Hot Shop by a 24 ft wide x 19 ft high passage under the Hot Shop wall.[2-1] The north wall of the Hot Shop extends down 5 ft into the pool to shield the pool area against radiation sources in the Hot Shop.[2-2] Plan and elevation views are shown in Figure 2-7.

A 13-ft-long × 11-ft-wide pool transfer cart is used to transfer items between the Storage Pool and Storage Pool vestibule. The cart is rated for 60 tons and rides on a pair of 91-ft-long rails laid in a 3-ft-deep trench at the bottom of the Storage Pool and Storage Pool vestibule. The pool transfer cart is powered back and forth along the rails by an endless cable system driven at speeds up to 40 ft/min by an electric winch located out of the water at the north end of the Storage Pool. The top of the pool transfer cart is approximately 2 in. above the floor level of the Storage Pool. Materials are loaded on and off the pool transfer cart using the 110/10-ton overhead crane in the Hot Shop and 15-ton bridge crane within the Storage Pool area.

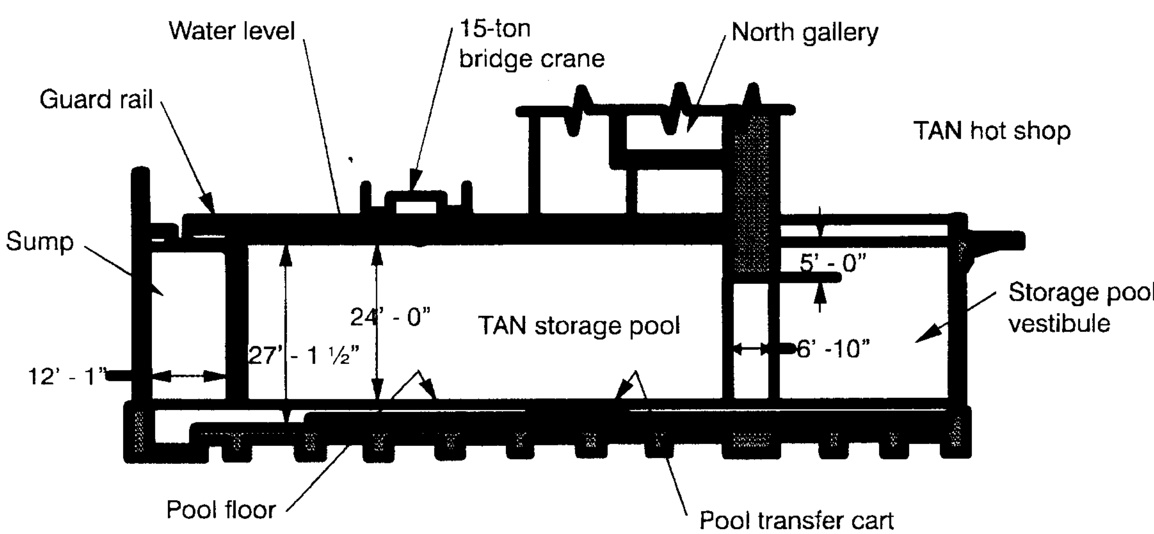
A work area for personnel surrounds the pool (except on the south end), providing access to the pool parapet and cranes in the Storage Pool room. Two cranes serve the Storage Pool area: 15-ton bridge crane and 30-ton tram hoist. The 15-ton bridge crane spans the Storage Pool on 75-ft rails mounted on the pool-side parapets.

Two 500-lb-capacity personnel platforms are available to provide greater visual guidance for work being performed with the 15-ton bridge crane. Travel limits for the bridge vary from 6 to 9 ft from the north and south bumpers, depending on where the travel limits are set. The travel limits for the trolley are adjustable to within 18 in. of the rail's end. No lower-limit switch exists for the hook motion; however, an upper-limit switch prevents the hook and rigging from colliding with the hoist. An additional interlock is connected to a remote area monitor (RAM), which disables the "up" motion if the RAM setpoint is exceeded. An override-key switch is provided to continue the "up" motion if conditions permit or if the situation requires such action. The 15-ton bridge crane is controlled by one of two six-button control pendants, one on each side of the hoist trolley. Dual control is prevented by electrical interlocks. The hoist, trolley, and bridge each have two buttons used to operate them. Motion speed increases with increased pressure on the pushbuttons.

The 30-ton tram hoist has rails that extend from a truck-loading platform through doors on the west side of the Storage Pool room to about 11 ft over the pool. The 30-ton tram hoist provides a means for bringing casks and other large objects directly into the Storage Pool. However, it is not used because it does not provide adequate clearance over the Storage Pool parapet. The 30-ton tram hoist is tagged out and there are no plans to put it back into service.



TAN storage pool plan view



TAN storage pool elevation view

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Figure 2-7. Plan and elevation view of TAN Storage Pool.

To maintain water quality, the TAN Storage Pool is equipped with a water treatment system. Also, materials placed in the Storage Pool are evaluated for high levels of contamination and damaged or exposed spent nuclear fuel to minimize cross-contamination of the water. If necessary, such materials are encapsulated in special containers.

The purification system consists of a circulation pump, located at the north end of the Storage Pool room, and two filters and a resin ion-exchange block, located in the water filtration buildings (TAN-608 and TAN-649), which are connected to TAN-607 at the north end of the Storage Pool. The pump circulates the pool water through the two filters and the ion-exchange block and back to the Storage Pool. The ion-exchange columns are enclosed in a disposable concrete block to provide shielding. During changeout of the ion-exchange columns, the whole block is removed and a new column is installed. The used block is transported to a waste disposal area.

The water volume in the TAN Storage Pool changes based on evaporation, movement of items into, out of, and within the pool, and makeup. In addition to manual checks, a leak detection system treats the water in the pool as a control volume and determines changes in the level of the pool based on the volume of water entering or leaving the control volume. A series of sensors and transducers provides the information required to calculate the evaporation rate for the pool and to measure the makeup water added to the pool. The estimated pool level is then compared to the actual measured level of the pool. If the measured level is consistently less than the estimated level of the pool, then water is leaving the pool other than by evaporation. If the loss of water is not accounted for by activities in the pool, then a leak is present. The system is capable of detecting leaks larger than 40 gpm within 15 minutes of initiation of the leak. It can also detect leaks as small as 25 gph when monitored over a 24-hour or longer period.

If a leak is detected, water can be added to the pool at a rate of approximately 25 gpm from the 10,000-gal tank of demineralized water. If the demineralized water system cannot maintain the water level, emergency injection water is provided from the TAN firewater system. The injection water fill-line enters the Storage Pool room through the east wall and extends approximately 6 ft over the edge of the Storage Pool. The isolation valve is located in Room 220 and is opened manually.

The TAN firewater and emergency injection system receives water from a 500,000-gal storage tank filled from underground wells. Firewater pumps supply a main firewater header for all of TAN. The two electric-powered pumps each have a 1,000 gpm capacity. Another pump is diesel-driven with a 1,500 gpm capacity and receives power from the TAN-603 diesel generator if commercial power is lost.

2.3.4 Hot Cell Annex

The HCA, located in TAN-633, adjoins TAN-607 on the north side and consists of four adjacent hot cells and the necessary support areas, as shown in Figure 2-8. The Hot Cell Annex is out of service.

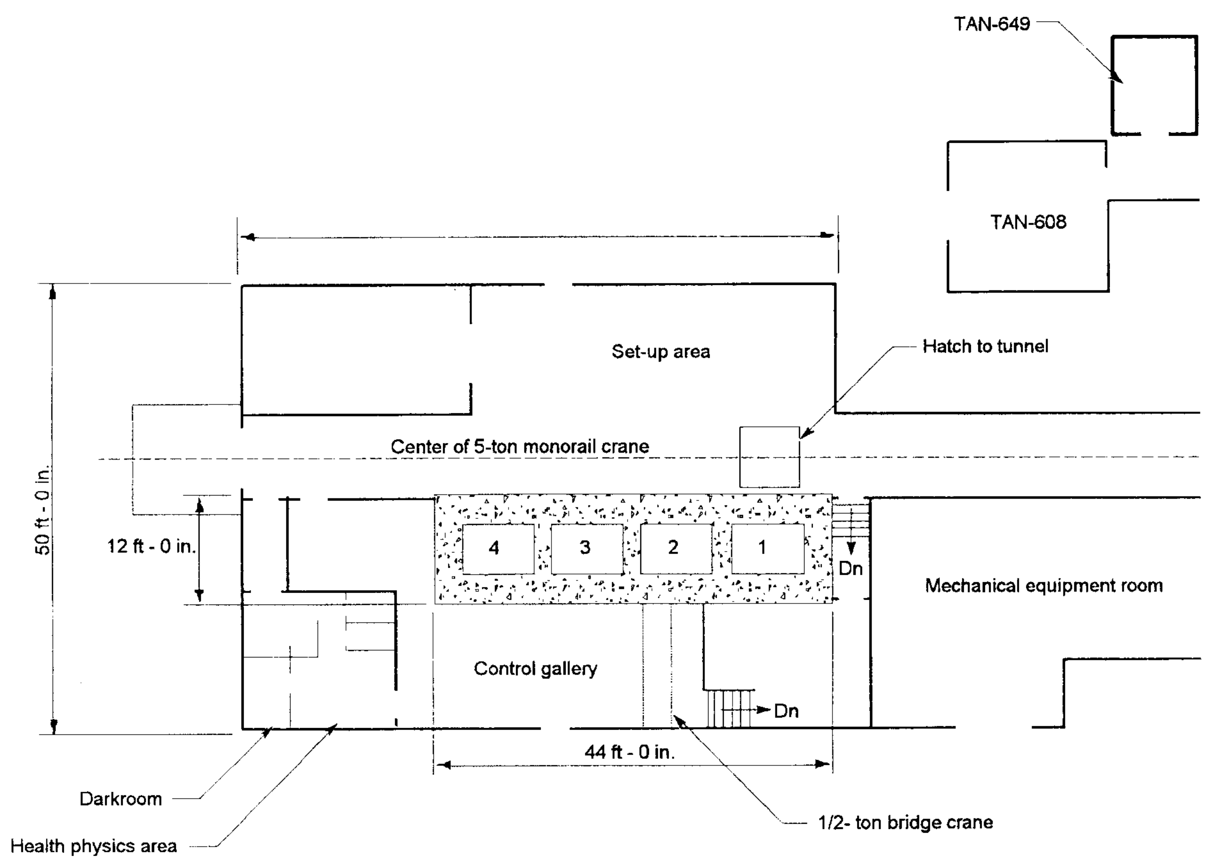

Figure 2-8. Floor plan of the Hot Cell Annex.

Identical oil-glass laminated viewing windows are located in the west wall of each cell. The windows are designated as Type 1 (as discussed for the TAN Hot Cell). Each window contains six panes of glass. Spaces between the panes typically filled with mineral oil for viewing clarity. S window is partially drained of oil. Gamma-ray attenuation through the HCA viewing windows is approximately equivalent to the 3 ft thick, high-density concrete wall.

2.3.5 TAN Warm Shop

The TAN Warm Shop is located adjacent to the south wall of the TAN Hot Shop. It is approximately 80 ft long and has a usable floor area that is approximately 40 ft wide. The four-track railroad system extends approximately 75 ft into the Warm Shop from the west biparting doors.

The Warm Shop area is serviced by a Warm Shop bridge crane traveling on rails that are 78 ft long, span 63.7 ft, and are 39.25 ft from floor level to the top of the rails. The capacity of the main hook is 30 tons and the capacity of the auxiliary hook is 5 tons.

The floor of the Warm Shop is of similar construction to the Hot Shop and has a high load capacity on the railroad track area. An analysis was conducted that shows that the track area will support a cask of up to 75 tons centered on the rails.[2-9] The analysis also shows that the cask transporter, with a combined load and vehicle weight of 132.5 tons, can be operated in an area centered on the tracks, as shown in the Warm Shop floor plan (Figure 2-9).

The TAN Warm Shop is a registered hazardous waste accumulation area. Also, the Warm Shop is operated as a fissile material control area. However, fissile material is restricted to approved shipping or storage casks that remain sealed while in the Warm Shop.

2.3.6 Decon Shop (TAN-607 Rooms 159, 160, and 160A)

Rooms 159, 160, and 160A are located in the southwest corner of TAN 607. The approximate room dimensions are 42 × 36 ft for Room 159, 8 × 36 ft for Room 160, and 13 × 36 ft for room 160A. Room 159 has a 30 Ton bridge crane and Room 160A contains the electrical ventilation systems (currently out of service) and steam pipe systems for Room 159.

From 1957 to about 1987, Room 159 was used to decontaminate equipment, Room 160 was an anticontamination clothing change room, and room 160A contained ventilation, electrical, and steam distribution equipment for room 159. All three rooms were taken out of service in 1987. Recent remediation efforts in these rooms involved removing decon equipment from Room 159, decontaminating

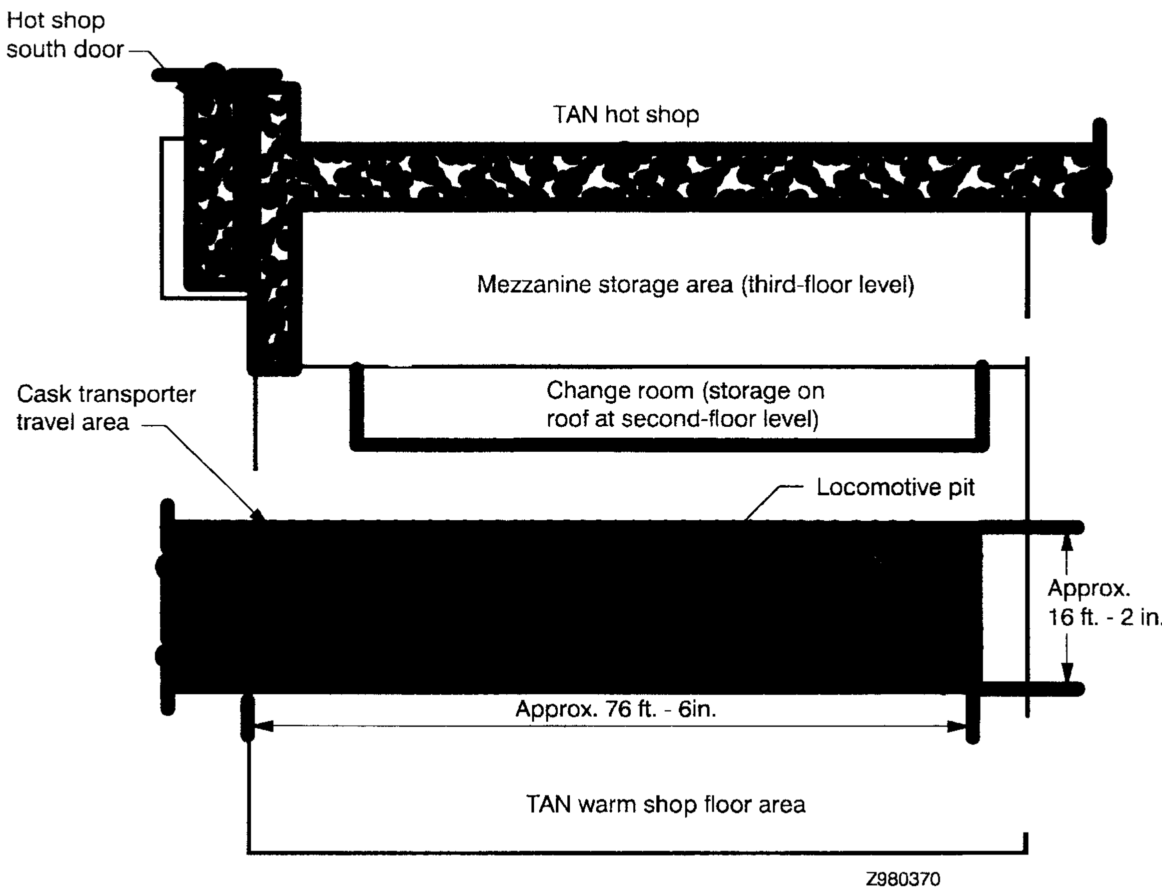

Figure 2-9. Floor plan of the TAN Warm Shop.

the room and equipment which included replacing the HEPA filters in the HEPA bank, and removing asbestos containing material from the steam pipes. Some fixed contamination in Room 159 has been painted over on the floor and up to 8 ft high on the walls.

Current and planned uses for Room 159 are cask dismantlement, storage of contaminated and noncontaminated materials, and storage, handling, and repackaging of mixed hazardous wastes.

2.3.7 Liquid Waste Treatment Plant (TAN-616)

TAN-616 consists of several underground waste tanks, an evaporator facility, and associated piping. The plant operated between the mid-1950s and the mid-1980s. TAN-616 has not been operational since 1985. Before this date, liquid waste entered the building and its associated tanks from various parts of TAN-607. The lines into TAN-616 have been cut and capped to preclude using this equipment.

TAN-616 is concrete building, 36 × 46 × 15 ft, located 60 ft north of TAN-607. The building is sectioned internally into an evaporator pit, valve-operating room, caustic pump room, control room, vestibule on the ground level, and pump in the basement. Associated tanks include three 10,000 gal, horizontal stainless-steel tanks located approximately 10 ft underground (V1, V2, V3), two 50,000 gal stainless-steel tanks (V13, V14), located approximately 15 ft under ground and one 400 gal stainless-steel tank (V9) approximately 7 ft underground. The three liquid waste storage tanks (V1, V2, V3), collectively referred to as TAN-1703 (see Figure 2-10), located approximately 9.8 ft east of TAN-616, were in service until 1985. Each tank is 10 ft in diameter and 16 ft long, seam to seam. A 20-in. manhole in the top of each tank is accessible from the surface through a 6-ft-diameter culvert. Approximately 30 ft east of TAN-616 is tank V-9. The tank is accessible through a 6 in. standpipe. Tanks V13 and V14 are located approximately 300 ft West Northwest of the TAN-616 and parallel to Snake Avenue in an area known as PM-2A. V13 and V14 are 55 ft long and 12.5 ft in diameter and accessible through a manhole 5.5 ft in diameter.

The V-tanks are located in Waste Area Group 1 of the INEL Federal Facility Agreement/Consent Order and have been investigated for environmental remediation.

2.3.8 Radioactive Liquid Waste Storage and Transfer Building (TAN-666)

TAN-666 is a steel-reinforced concrete structure located west of the TAN Hot Shop, across the paved access road. The facility is designed to receive and temporarily store liquid waste generated in the TAN Hot Shop, Hot Cell, and HCA. The building contains a tank vault, pump vault, filter shed, and outside concrete pad. The equipment and instrumentation are shown in Figure 2-11. Most of the valve manipulations are accomplished with reach rods; in this way, the physical structure of TAN-666 provides shielding for operations personnel.

The tank vault is a rectangular room with 2 ft thick concrete walls and floor. The dimensions of the vault are 33 × 28.5 ft, with a wall height of 20.5 ft. The floor of the tank vault is 7 ft below ground level. The only entrance is through a double set of steel doors located in the center of the west wall.

The tank vault contains two 15,000-gal storage tanks that rest horizontally, side by side, with a 5 ft high concrete wall separating them. The floors are sloped below each tank so that any liquid spilled collects in a catch basin sump. There are two sumps, one each located to the east of the respective tanks. Each tank is vented to the atmosphere and has an overflow line that discharges to its sump. The sump then gravity-drains to a surge tank located in the pump vault.

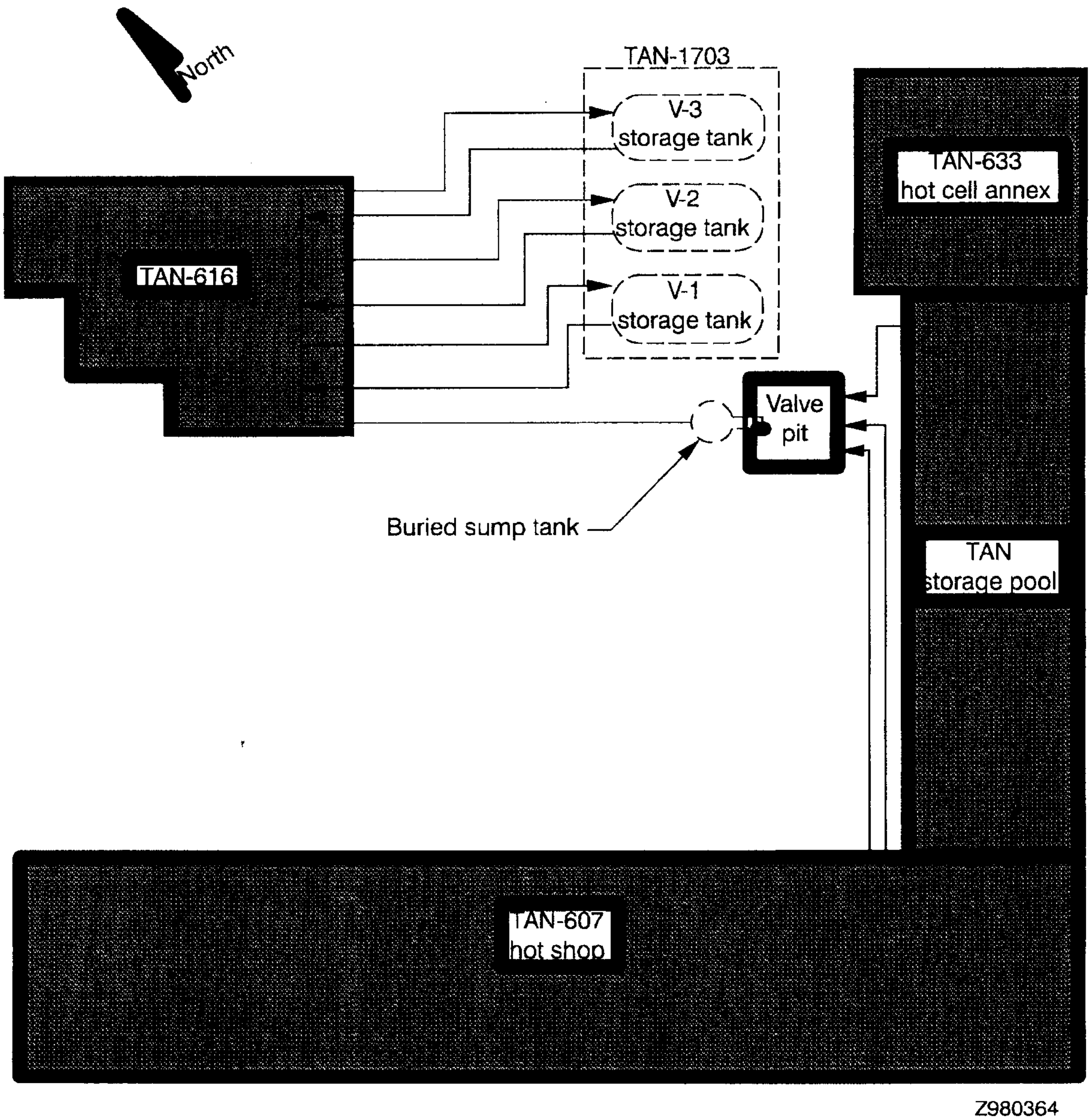

Figure 2-10. Location of TAN-616 and TAN-1703.

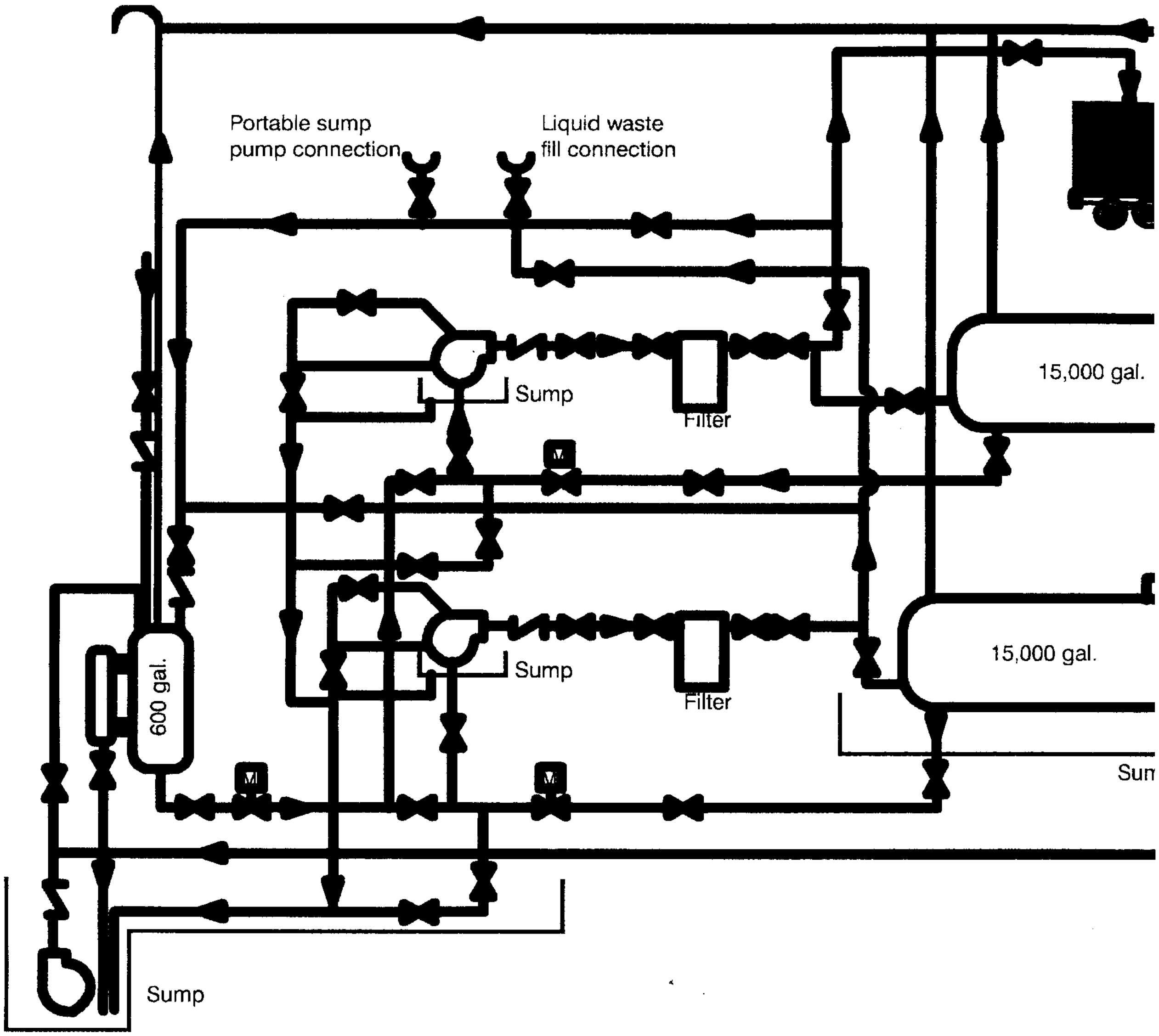

Figure 2-11. Equipment and Instrumentation of the Radioactive Solid Waste Storage and Transport Building.

The pump vault is located to the east of the tank vault and its roof is at ground level. The walls and floor of the pump vault are 1.5-ft-thick, steel-reinforced concrete. The inside dimensions of the room are 19 × 28.5 ft, with a wall height of 20.5 ft. A 1.5-ft-thick concrete pad at grade level forms the roof of the pump vault; a single entrance manway is located at its northeast corner. A vertical steel ladder bolted to the east wall permits an operator to climb down to the pump vault floor.

The pump vault contains a vertical 600 gal capacity surge tank and two 200 gpm waste transfer pumps. The tank is located in the northwest corner of the pump vault and receives waste by gravity flow from valve pit #1, the sumps, and the truck vent and overflow line. The transfer pumps are located in the south end of the vault. They transfer liquid waste from either storage tank or the surge tank to another storage tank, or to a transfer truck for disposal.

A pump vault sump is located by the south wall of the pump vault. Its operation is automatically controlled by a float switch. When the sump reaches a predetermined level, it pumps the contents of the sump back to the surge tank.

The filter shed is attached to the south side of the tank vault at ground level. The inside dimensions of the shed are 14 × 7 × 10 ft. Access to the vault is through a double carbon-steel door located on the south side of the tank vault.

The shed contains a cyclone separator and associated piping, which is used to filter out particulates from the waste to prevent clogging and to help minimize the buildup of sludge in the storage tanks. The material collected by the separator is directed to a sludge tank. The sludge tank is designed to be removed, cleaned, and replaced.

A 8-in.-thick 20 × 70-ft concrete pad has been constructed just east of the pump vault to accommodate waste transfer vehicles used for removing accumulated liquid waste. Liquid waste is pumped from the storage tanks through an overhead pipe boom and flexible connecting hose into tank trucks parked on the pad.

2.3.9 Radioactive Parts Service and Storage Area

The Radioactive Parts Service and Storage Area (RPSSA) consists of two buildings (TAN-647 and TAN-648) and two concrete storage pads. Items stored in the RPSSA typically cannot be stored in other facilities because of their radiological condition or size, or they are those awaiting processing or transportation. Items are packaged so to contain any radioactive material, resist deterioration, and contribute the least practical fire loading.

In general, items are stored in TAN-647 or TAN-648 rather than outside on the pads because of the protection provided by the buildings against the elements. Both TAN-647 and TAN-648 are designated for radioactive, hazardous, and mixed hazardous material storage. To avoid personnel encountering unknown hazards, materials prohibited from storage in TAN-647 and TAN-648 include explosive material, shock-sensitive material, and pressurized containers. Ignitable, corrosive, reactive, or toxic materials as defined by 40 CFR 261 are allowed for storage only in the Resource Conservation and Recovery Act-(RCRA) permitted section of TAN-647. For fire prevention precautions, combustible materials in TAN-647 and TAN-648 are limited to that necessary for packaging and containment.

The two buildings were constructed in the 1950s to the then-current criteria published in the *Atomic Energy Commission Manual*, Chapter 6301. TAN-647 is a 34 × 142 ft unheated building constructed of corrugated sheet metal on a steel frame. The north 48 ft of the floor is industrial concrete with a capacity of 6,000 lb/ft^2; the remainder is constructed of 3 ft of select, compacted material to a 100% density with a rated capacity of 4,000 lb/ft^2. TAN-648 is a 69 × 96-ft unheated building constructed of corrugated sheet metal on a steel frame. The entire floor is a concrete slab with a rated capacity of 2,500 lb/ft^2. Personnel access doors are located on both the north and south walls of each building. Electrically operated equipment doors are located on the north wall of each building and also on the south wall of TAN-647.

Access to both buildings is by a deteriorated asphalt road from the north. TAN-647 is also accessed by a double railroad track from the south, which extends part way into the building and connects to the TAN railroad system.

2.3.10 Cask Pads

The following sections contain information on the TMI-2 Abnormal Waste Storage Pad (TAN-790) and the Spent Fuel Storage Cask Testing Pad (TAN-791). It also includes casks associated with these pads as well as other casks used elsewhere in the facility.

2.3.10.1 TMI-2 Abnormal Waste Storage Pad (TAN-790)

The 40 × 108-ft TMI-2 Abnormal Waste Storage Pad is located about 350 ft west of TAN-607, near the existing railroad bed; the south boundary of the pad is 4.6 ft from the nearest rail (see Figure 2-12). The pad is constructed of 8-in.-thick reinforced concrete with design compressive strength of 3,000 psi at 28 days. The combination of paving and base supports the weight of the casks, which is approximately 40 tons. The pad is sloped slightly (3%) to enhance runoff. A gutter surrounds the pad and drains to a single outlet. A small basin near the outlet provides a collection point for water samples for radiological analysis.

As many as 30 casks can be stored on the pad in a 3 × 10 array, with 16 in. between casks. The casks are placed no less than 2.5 ft from the edge of the pad and are oriented so that vent and drain penetrations are accessible in the storage configuration. The liners are vented to the atmosphere through filters attached to the liners.

A 4-ft-high fence surrounds the pad to prevent inadvertent intrusion. The fence has removable sections so that casks can be moved on and off the pad, and an entry has been installed for personnel access. The storage pad is posted as required by the *INEL Radiological Control Manual.*

Each storage cask is constructed of 2-ft-thick reinforced concrete. The concrete has a minimum compressive strength of 4,000 psi and satisfies the requirements of American Concrete Institute ACI-318-77. Each storage cask is approximately 9 ft in diameter and 9.5 ft high, with a recessed, reinforced concrete lid weighing 4.75 tons. The total weight of each cask is approximately 34.5 tons empty and 40 tons loaded.

The casks are designed to hold either one 4 × 4 liner, three 2 × 4 liners, three 55-gal drums, or eight 30-gal drums (stacked two high). Each cask has a 1.8-in. 700-lb, carbon-steel raincover with sufficient overlap to prevent windblown rain from entering the cask. The raincovers are painted with white epoxy to inhibit corrosion and are compatible with design snow loads at TAN.

Separate vent and drain capabilities are provided for the casks by external openings near the top of the cask cavity. Both vent and drain systems are provided with outside plugs. The drain system is designed so that the liquid level can be measured, but pumping is required to remove any liquid. The

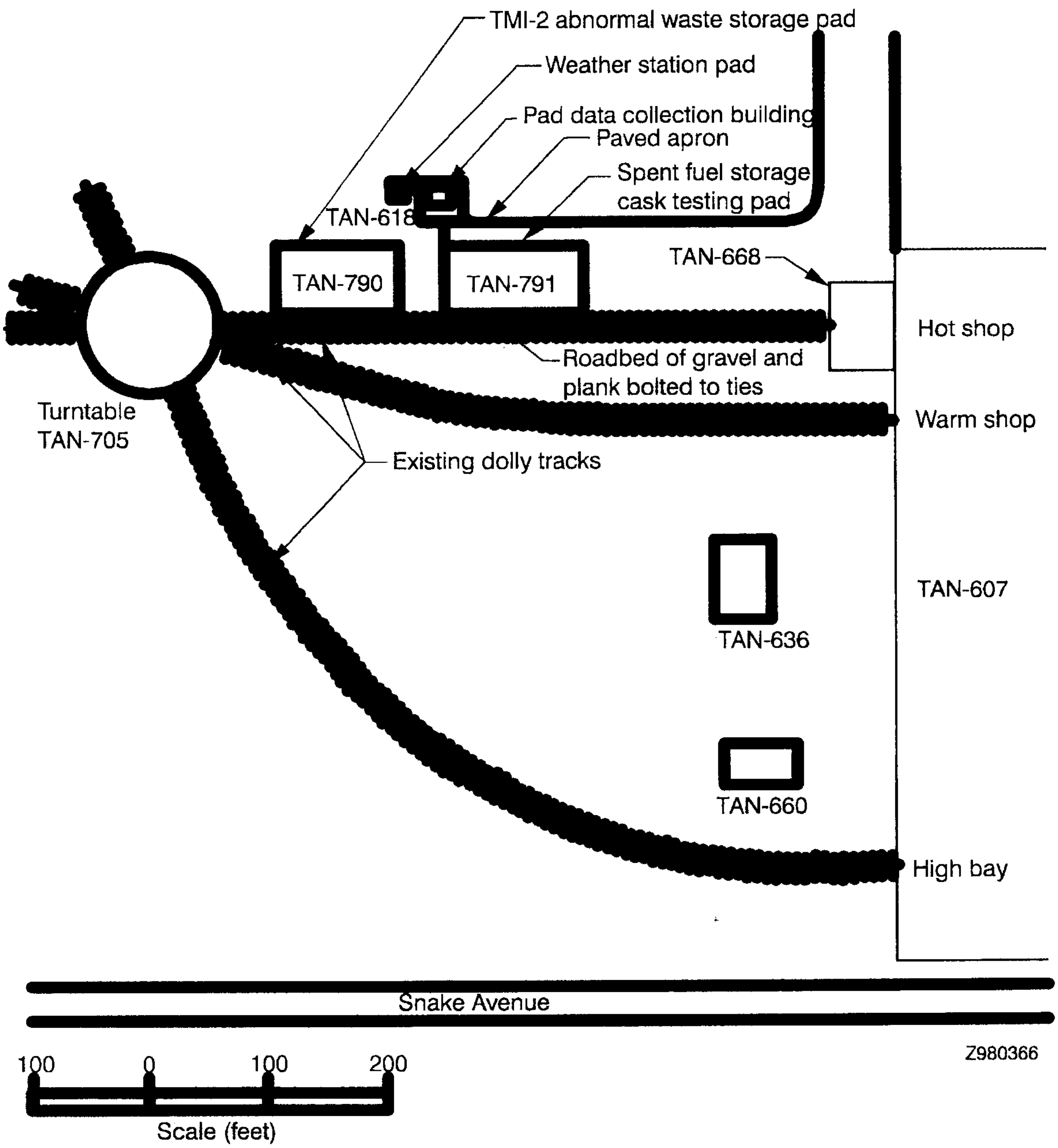

Figure 2-12. Location of the cask pads.

need to remove liquid is assessed on a case-by-case basis, depending on the waste form involved. The removal and disposal of liquid must be in compliance with all applicable regulations. All penetrations are designed to minimize radiation streaming, and the casks are designed for a useful life of 30 years.

The casks are designed to hold either one 4 × 4 liner, three 2 × 4 liners, three 55-gal drums, or eight 30-gal drums (stacked two high). Each cask has a 1.8-in. 700-lb, carbon-steel raincover with sufficient overlap to prevent windblown rain from entering the cask. The raincovers are painted with white epoxy to inhibit corrosion and are compatible with design snow loads at TAN.

Separate vent and drain capabilities are provided for the casks by external openings near the top of the cask cavity. Both vent and drain systems are provided with outside plugs. The drain system is designed so that the liquid level can be measured, but pumping is required to remove any liquid. The need to remove liquid is assessed on a case-by-case basis, depending on the waste form involved. The removal and disposal of liquid must be in compliance with all applicable regulations. All penetrations are designed to minimize radiation streaming, and the casks are designed for a useful life of 30 years.

Direct radiation surveys and smears of casks and the pad are conducted by a radiological control technician (RCT). Continuous cask monitoring for vented radioactivity is not anticipated. Waste containers in the storage casks are either plugged or filtered to prevent release of radioactivity; storage cask vents and drains are not filtered, the cask lids are not sealed, and the raincovers are vented. Smear data are obtained from locations near accessible external openings to assess and monitor contact exposure rates at those locations. An increased rate may indicate venting of gas from the contents of the cask. The casks are designed so that a monitoring system can be installed if surveillance results indicate a need.

2.3.10.2 Spent Fuel Storage Cask Testing Pad (TAN-791)

The 40 × 94 ft testing pad is located about 200 ft west of TAN-607, near the existing railroad bed. The south boundary of the testing pad is 4.6 ft from the nearest rail (see Figure 2-12) and is at the same level as the railroad bed to minimize the height to which casks are raised during transfers. The testing pad is constructed of 2-ft-thick reinforced concrete with a design compressive strength of 4,000 psi at 28 days. It is sloped slightly (3%) to enhance runoff.

A 4-ft-high fence surrounds the pad to prevent inadvertent intrusion. The fence has removable sections so that casks can be moved on and off the pad, and an entry has been installed for personnel access. The pad is posted as required by the *INEL Radiological Control Manual.*

The Pad Data Collection Building (TAN-618), located 30 ft northwest of the testing pad, contains instrumentation needed for monitoring activities and cask performance testing (see Figure 2-12). TAN-618 is a metal building that has been secured at the bottom to an 11 × 11-ft slab of 4-in.-thick reinforced concrete.

Casks may be transferred between the testing pad and the TAN Hot Shop using the spent fuel cask transporter (see Section 2.3.1.12). There are different types of casks used for the Spent Fuel Storage Cask Testing Program. These are discussed in the following paragraphs. There are also casks to be used for interim dry storage at TAN-791 of fuels removed from the Storage Pool as part of the TAN Pool Stabilization Project. Those casks are described in Addendum 1 (NuPac 125B-2 for TMI-2 canisters containing epoxy) and in Addendums 2 and 3 (TN-24P and REA-2023 casks for LOFT/commercial fuels) to this SAR.

2.3.10.2.1 GNS CASTOR V21 Cask

The General Nuclear Systems (GNS) CASTOR V/21 cask is a thick-walled, nodular cast-iron cylinder approximately 7.87 ft in diameter; it weighs approximately 113 tons. The cask has a cylindrical cavity that holds a fuel basket designed to accommodate up to 21 pressurized water reactor (PWR) spent nuclear fuel assemblies.[2-10] The cask cavity is 5 ft wide and 13.78 ft long, with side-walls is 1.3 ft thick. The cask contains multiple confinement barriers.

The internal heat transfer medium of the cask is an inert gas (helium or nitrogen). Gamma and neutron radiation is shielded by the cast-iron wall of the cask, which includes sections of neutron-moderating material. Gas intake and exhaust air are accommodated via a valve in the primary shield cover. The cover system is fitted with a leak-testing device and has a multiple seal consisting of metal and elastomer O-rings. Features of the GNS CASTOR V/21 cask and closure system are shown in Figure 2-13. The main components of the GNS CASTOR V/21 cask are described in Reference 2-10.

2.3.10.2.2 TN-24P Cask

The Transnuclear (TN)-24P cask is used for storage of up to 24 PWR spent nuclear fuel assemblies or 24 canisters of consolidated nuclear fuel rods. The total weight of the cask when fully loaded is approximately 86 tons.[2-11] The overall containment vessel is 16.6 ft long and the side wall is 9.5 in thick. The cylindrical cask cavity is 13.8 ft long and 4.8 ft in diameter. The TN-24P cask is illustrated in Figure 2-14.

The basic structure of the TN-24P cask is a cask body of thick-walled forged steel with an integrally welded forged bottom and a flanged and bolted forged top. The spent nuclear fuel is stored in an inert gas atmosphere. Heat generated by the spent nuclear fuel assemblies is rejected to the surrounding air by convection and radiation. No forced cooling or cooling fins are required. A neutron shield drum is installed on the cask lid to provide extra shielding. A protective cover is installed as a weather shield during storage. A more detailed description of the TN-24P cask is provided in References 2-11 and 2-12

2.3.10.2.3 Westinghouse MC-10 Cask

The Westinghouse MC-10 cask is used for storage of up to 24 spent nuclear fuel assemblies or 24 canisters of consolidated spent nuclear fuel rods. The MC-10 cask consists of 24 stainless-steel cells in an aluminum basket structure. Each cell consists of an enclosure, neutron poison material, and limiter blocks. The enclosure is formed to provide an 8.75-in.-inside square envelope for spent nuclear fuel assembly storage.[2-13]

The cask vessel is a forged steel container with an integrally welded, forged steel bottom. The cask cavity is 188 in. long, 88 in. in diameter, and has a side-wall thickness of 10 in. Stainless-steel neutron-absorbing material jackets the outside surfaces of the vessel wall and base. Twenty-four nickel-plated fins project through the jacket on the vessel walls to increase heat dissipation from the cask.[2-13]

The vessel closure system is a series of four covers: (1) a shield cover, a 5 × 75.5-in. plate of low-alloy steel bolted to the cask vessel; (2) a primary cover, a 3.5 × 85.88-in. plate of carbon steel located atop the shield; (3) a seal cover, a 1× 87.12-in. plate of carbon steel mounted over the other two covers; and (4) a closure cover, a 5 × 94.5-in. stainless-steel weldment containing neutron-absorbing shielding material placed atop the seal cover.[2-13]

When fully loaded, the total weight of the MC-10 cask is approximately 113.3 tons. A schematic of an MC-10 cask is shown in Figure 2-15 and a more detailed description is provided in Reference 2-13.

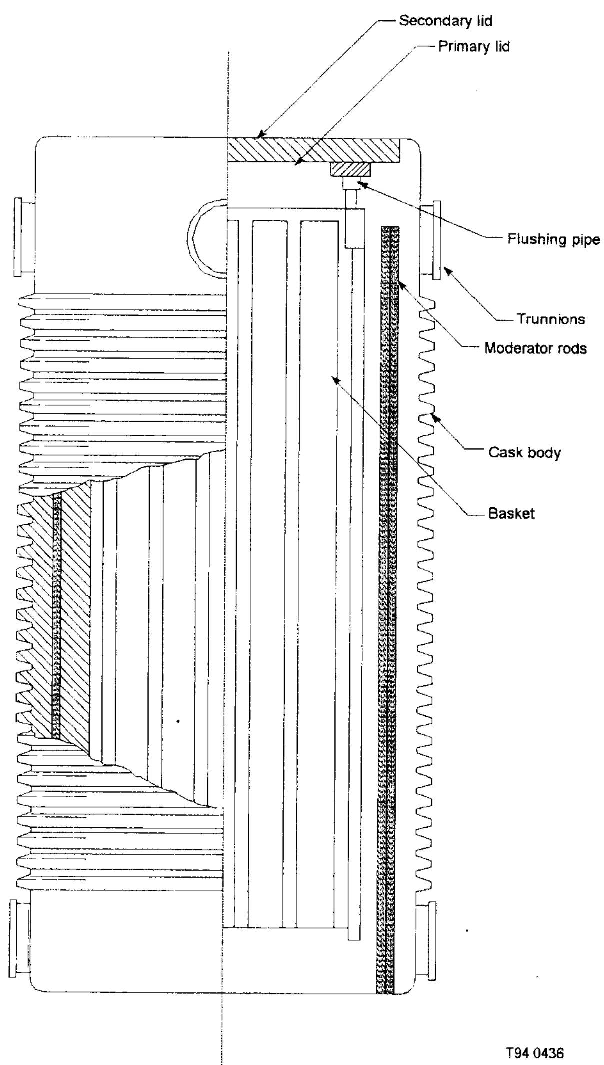

Figure 2-13. Features of the GNS CASTOR V/21 cask.

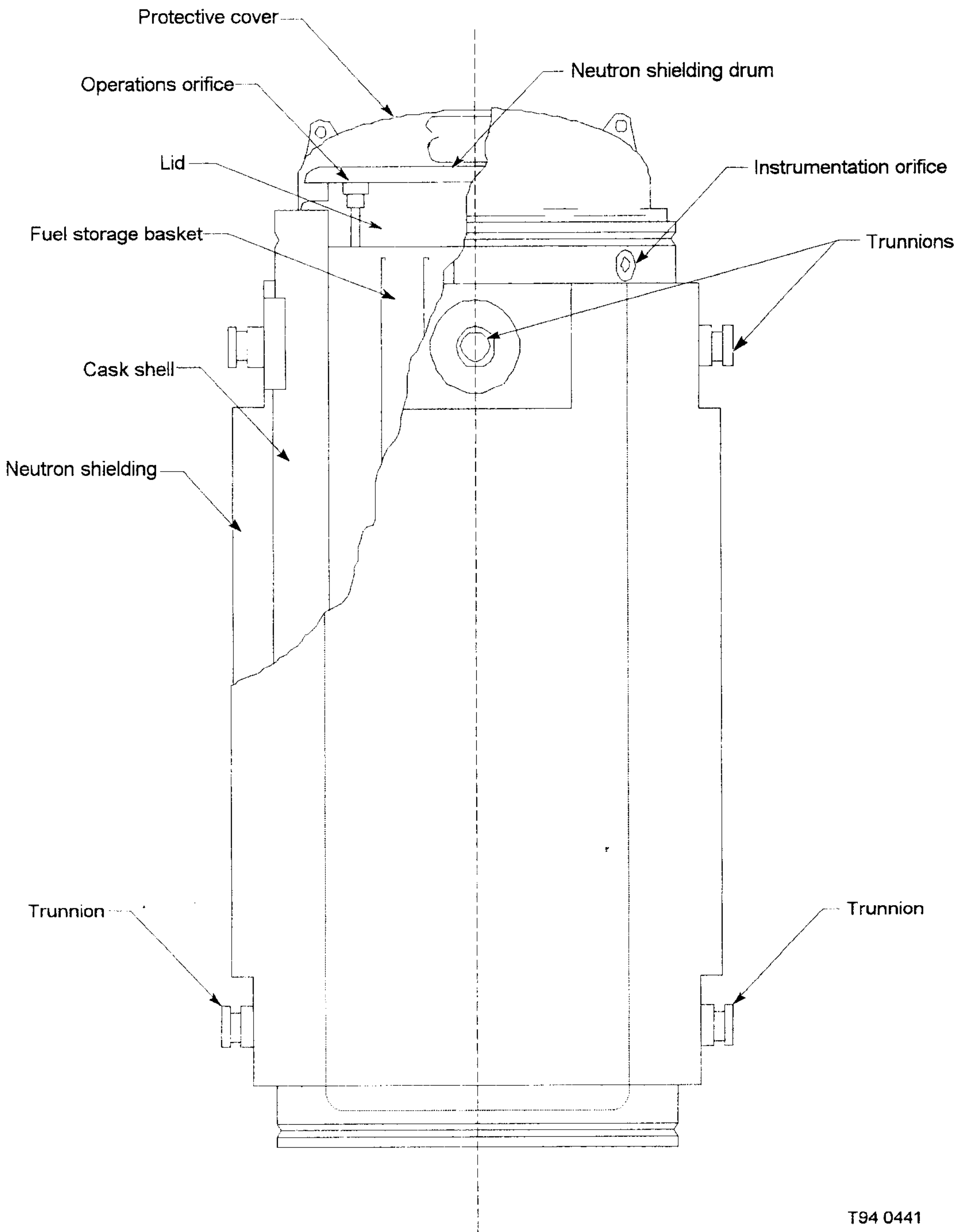

Figure 2-14. TN-24P cask overview.

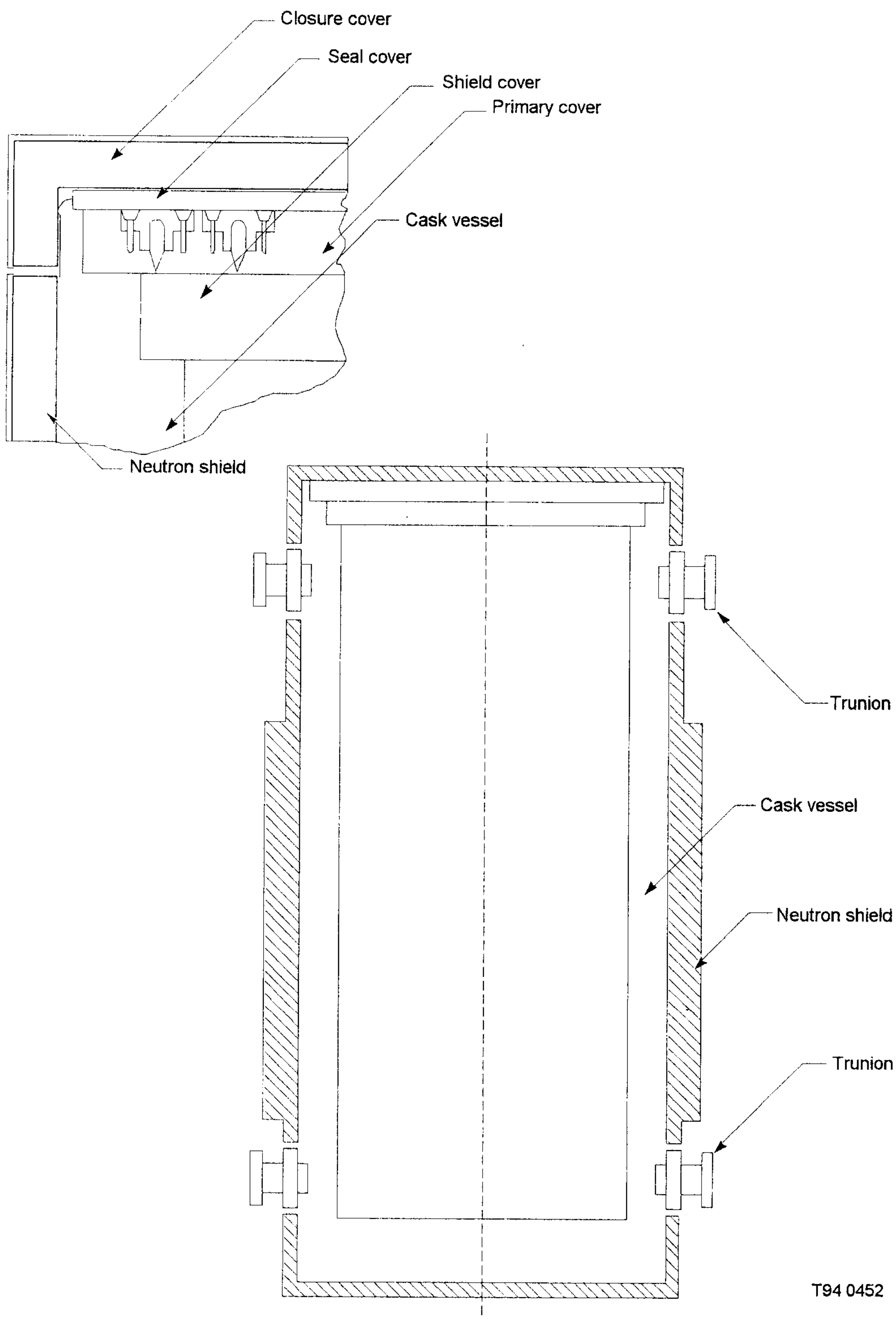

Figure 2-15. Westinghouse MC-10 cask vessel assembly.

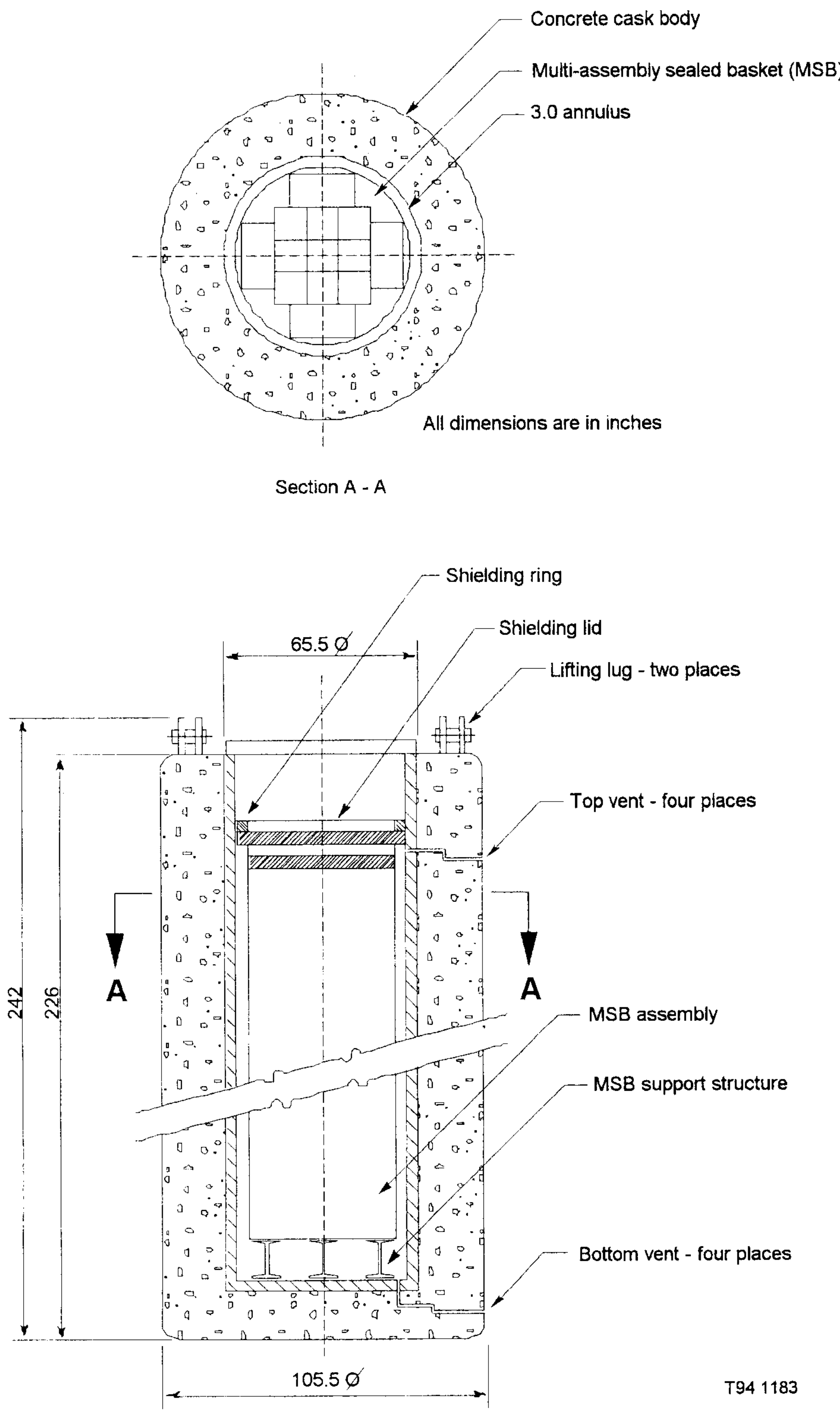

Figure 2-16. VSC-17 spent fuel storage cask.

2.3.10.2.4 VSC-17 Cask

The following descriptive information was obtained from the Topical Safety Analysis Report[2-14] and the Ventilated Storage Cask (VSC)-17 Operation and Maintenance Manual.[2-15]

The VSC-17 cask is a dry storage system using a concrete storage cask and a steel, multi-assembly sealed basket (MSB) to safely store canisters of consolidated irradiated spent nuclear fuel. The VSC system can hold 17 PWR assemblies or 17 consolidated spent nuclear fuel canisters. This is the only type of fuel approved for storage in this cask without further analysis. Administrative controls limit storage to consolidated spent nuclear fuel canisters with at least 399 fuel rods per canister.

The VSC-17 cask structure consists of an outer shell assembly, which is fabricated from pressure vessel steel, a weather cover, and a shielding lid. Concrete walls provide structural support and enough shielding. to limit the exterior surface radiation dose rates to 50 mrem/hr or less. Natural convection inside the cask allows decay heat to be removed from around the metal walls of the cask liner and MSB. A 0.75-in.-thick steel-disk[2-14] weather cover is bolted to the metal inner liner of the concrete shell of the cask, with an elastomer gasket between the two, to prevent water intrusion (see Figure 2-16). The shield lid is made of one 4.5-in.-thick steel disk and one 6-in.-thick disk, which sandwich a 2-in.-thick section of neutron shielding. These assemblies are welded together to produce one lid.

The internal cavity of the concrete cask is formed by a 3.5-in.-thick steel cylinder. The MSB is a welded assembly fabricated from square steel tubes. The MSB is fabricated from 0.5-in. carbon steel and coated with a nonorganic, radiation-resistant, high temperature, hard surface coating to prevent oxidation. A 0.375-in-diameter metal O-ring and a 0.275-in.-diameter EPDM (ethylene propylene dimonomer) O-ring located in the MSB shielding lid ensure closure of the MSB.

2.3.10.2.5 TN-REG CASK

The TN-REG cask has a 71.74-in.-diameter cavity with a 9.25-in.-thick carbon-steel shell. The cask has 40 fuel baskets to hold Robert E. Ginna (REG) fuel assemblies. The rectangular baskets are 8.05 inches square inside with 0.276-in.-thick borated stainless-steel plates assembled in an "egg crate" configuration.

The NRC cask license allows up to twenty REG fuel assemblies for transportation. The baskets that are not loaded with fuel assemblies contain stainless steel replacement inserts. The fuel assemblies and fuel replacement inserts are placed in alternating compartments to form a checkerboard pattern. Aluminum basket peripheral inserts are installed at locations formed by the interface between the fuel basket and the cask cavity wall.

The basic structure of the TN-REG packaging includes a thick walled, forged steel containment vessel consisting of the right circular cask body and closure lid. Impact limiters are attached to both ends of the cask during shipment. The empty weight of the cask is approximately 175,000 lb, and 225,000 lb when it is fully loaded. The overall dimensions of the cask are 234 in. long and 131 in. in diameter, including impact limiters. With impact limiters removed, the external dimensions are 180 in. long and 90.25 in. in diameter.

The containment vessel is constructed of a 9.25-in.-thick forged steel. The 82.25-in.-diameter lid, with a maximum thickness of 8.5 in., is bolted to the cask with 48, 1-5/8-in.-diameter steel bolts. The cask is sealed with a Viton o-ring mounted in a groove machined in the underside of the lid. A second metallic o-ring is provided to leak test the Viton o-ring. The containment vessel is provided with access and vent ports in the lid and two gas-sampling ports and a research instrument port in the cask body. All of the penetrations are sealed up using Viton o-rings. Additional information can be found in reference 2-16

2.3.10.2.6 TN-BRP CASK

The TN-BRP cask has a 64-in.-diameter cavity with a 9.625-in.-thick carbon-steel shell. The cask has 85 fuel baskets to hold Big Rock Point (BRP) fuel assemblies. Two vertically stacked BRP assemblies fit within one basket. The rectangular baskets are 6.8 in. square inside a 0.276-in.-thick borated stainless-steel plates assembled in an "egg crate" configuration.

The NRC cask license allows up to 85 BRP fuel assemblies for transportation, two per compartment. For less than 85 assemblies, the baskets that are not loaded with fuel assemblies contain stainless steel replacement inserts. The fuel assemblies and fuel replacement inserts are placed in alternating compartments to form a checkerboard pattern. Aluminum basket peripheral inserts are installed at locations formed by the interface between the fuel basket and cask cavity wall.

The basic structure of the TN-BRP packaging includes a thick-walled, forged steel containment vessel consisting of the right circular cylindrical cask body and closure lid. Impact limiters consisting of balsa and redwood encased in carbon-steel shells are attached to either end of the cask. A fuel basket inside the cask cavity provides compartments for the transported payload. The total empty weight of the packaging is approximately 173,000 lb and total gross weight is approximately 215,000 lb. The overall dimensions of the TN-BRP cask are 244.5 in. long and 131 in. in diameter, including impact limiters. With impact limiters removed, the external dimensions are 190.5 in. long and 83.25 in. in diameter.

The TN-BRP is transported by rail, in a horizontal orientation, on a specially designed shipping frame. Cask-loading and unloading operations are performed with the packaging in a vertical orientation. The closure lid end is referred to as the top when the packaging is vertical and as the forward end when in the horizontal or transport orientation. Trunnions bolted to the cask body are provided for lifting and handling operations, including rotation of the packaging between the horizontal and vertical orientations.

The containment vessel is constructed of a 9.62-in.-thick forged steel. The 74.75-in.-diameter lid is bolted to the cask with forty-eight, 1-5/8-in.-diameter steel bolts. The cask is sealed with a Viton O-ring mounted in a groove machined in the underside of the lid. The containment vessel is provided with access and vent ports in the lid and two gas-sampling ports and a research instrument port in the cask body.

The maximum normal operating pressure of the TN-BRP is 6.0 psig. A cask cavity pressure of 45 psig is conservatively assumed for purposes of structural analyses. The spent fuel payload is shipped dry in a nitrogen atmosphere. The heat generated by the spent fuel assemblies is rejected to the surrounding air by convection and radiation. Acceptable performance of the containment boundary seal material (Viton) is demonstrated at temperatures down to -40°F.[2-17] Additional information can be found in Reference 2-18

2.3.10.2.7 REA-2023 Dry Storage Cask

The REA-2023 cask (see Figure 2-17) is an approximately 16 ft high × 8 ft diameter stainless-steel cylinder weighing approximately100 tons,[2-19] which uses an all-welded sealing method and passive heat

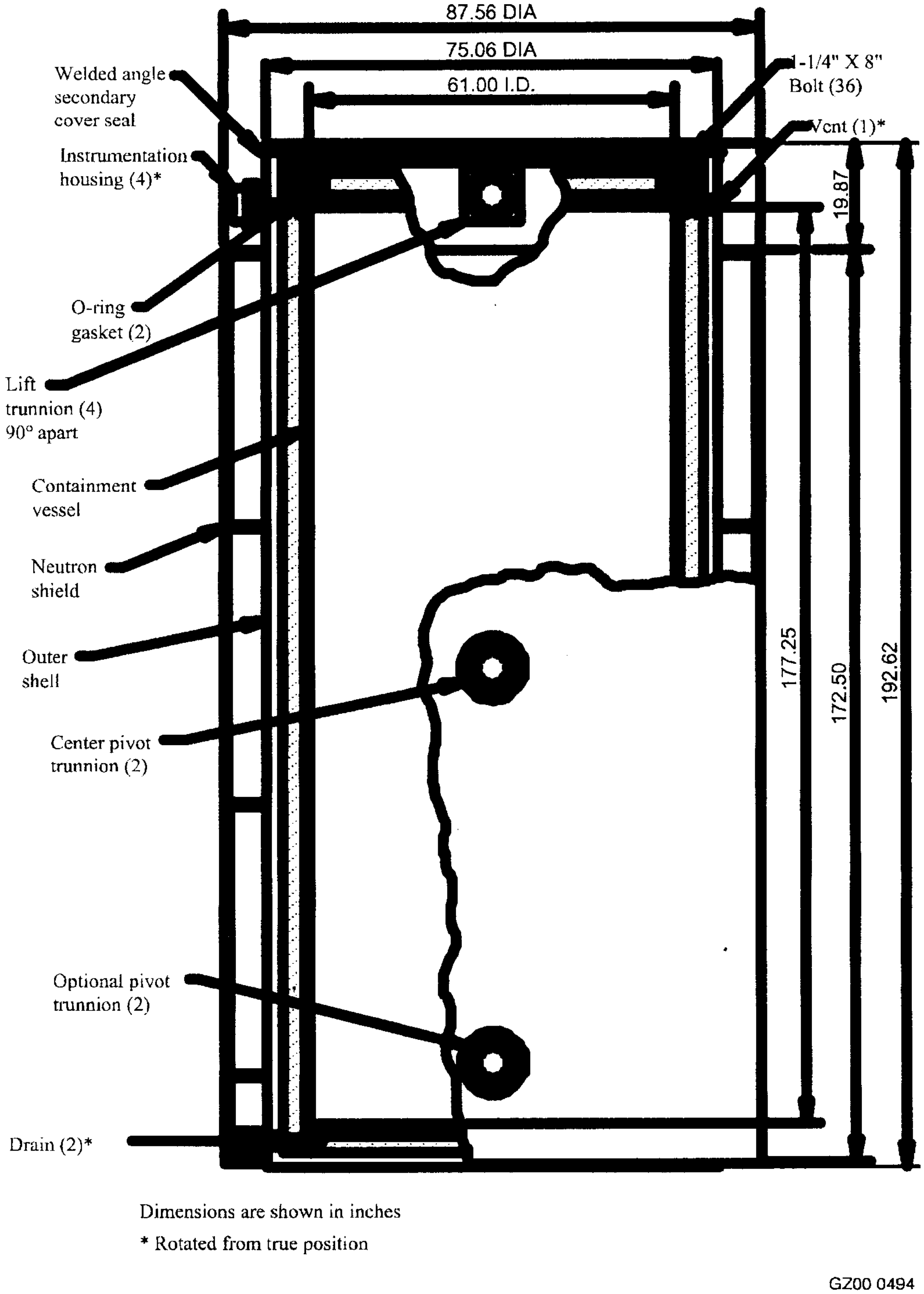

Figure 2-17. REA-2023 dry storage cask.

dissipation design for dry storage of irradiated fuel assemblies. This cask consists of a double containment design with a welded final closure on the secondary cover. The all-welded cask sealing method and passive heat dissipation modes are unique features of the REA-2023 cask. This passive design for dry storage of spent nuclear fuel minimizes the requirements for maintenance and surveillance. Remote monitoring of the internal pressure of the cask is all that is required to ensure the integrity of the cask's seals. Additional information concerning the REA-2023 dry storage cask can be found in the Topical Report: REA 2023 Dry Storage Cask for BWR Spent Fuel.[2-19] The various components include a smooth stainless-steel outer skin, a lead and stainless-steel gamma shield, a borated water and glycol neutron shield, and a basket constructed of copper, stainless steel, neutron absorbing plates, and a stainless-steel primary containment vessel. The cask body surrounds the spent nuclear fuel assembly basket, which is a four-quadrant basket designed to accommodate 52 intact boiling water reactor spent nuclear fuel assemblies.[2-19] However, the Spent Nuclear Fuel assembly basket has been removed and the heated vacuum drying system (HVDS) installed. The HVDS is used for drying the TMI-2 canisters. A description of the TMI-2 project is found in Addendum 1 of this SAR. The fuel assemblies can be up to 3.5% initial enrichment, irradiated up to 33,000 MWD/MTU, decayed for five years or more after irradiation, and generate 0.4 kW of heat per assembly.[2-19]

2.3.10.3 *Spent Fuel Cask Transporter*

The spent fuel cask transporter (see Figure 2-18) is used to hydraulically lift and move (via towing) various sizes of storage casks between the storage pads and the TAN Hot Shop, TAN buildings and areas, and other facilities at the INEEL. The cask transporter design, safety features, and operations meet the

standards listed in the Specifications for the INEL/TAN Dry Spent Fuel Storage Cask Transporter.[2-20] A detailed description and instructions for operation and maintenance of the cask transporter is in the Dry Spent Fuel Storage Cask Transporter Operation and Maintenance Manual. The transporter has standard railing and ladder access to both top and main transporter levels that is not shown in the figure.

2.3.10.4 OS-197 CASK

The OS-197 cask is licensed to the requirements of 10 CFR 72 for on-site transfer of the TMI-2 dry shielded canisters (DSCs) from TAN to INTEC. This cask has been analyzed for criticality, seismic, operational handling loads, accidental drop loads, thermal/dead loads, tornado, wind, and missile loads with respect to TMI-2 fuel. Additional fuels will have to be evaluated before they can be placed into this cask. The cask is not designed for internal pressure because the DSC and the double closure welds form the pressure containment boundary. In drop scenarios, the cask has been evaluated to have its lids remain intact from a drop of 100 inches onto the floor in the TAN unloading area. The transportation height limit of the cask is 80 inches.

The OS-197 cask has a 196.75-in.-long inner cavity, a 68-in. inside diameter, and a maximum canister weight of 70,000 lbs. The cask itself weighs 100,000 lbs. The maximum load weight of the cask and DSC with canister is 170,000 lbs. The main transfer cask body is constructed from two concentric cylindrical stainless-steel shells with a bolted top cover plate and a welded bottom end assembly. The annulus formed by these two shells is filled with cast lead to provide gamma shielding. The transfer cask also includes an outer stainless steel jacket that can be filled with water for neutron shielding or left empty. The top and bottom end assemblies incorporate a solid neutron shield material. The transfer cask is designed to provide sufficient shielding to ensure that dose rates are ALARA. Two lifting trunnions are provided for handling the transfer cask at TAN using a lifting yoke and an overhead crane. Lower

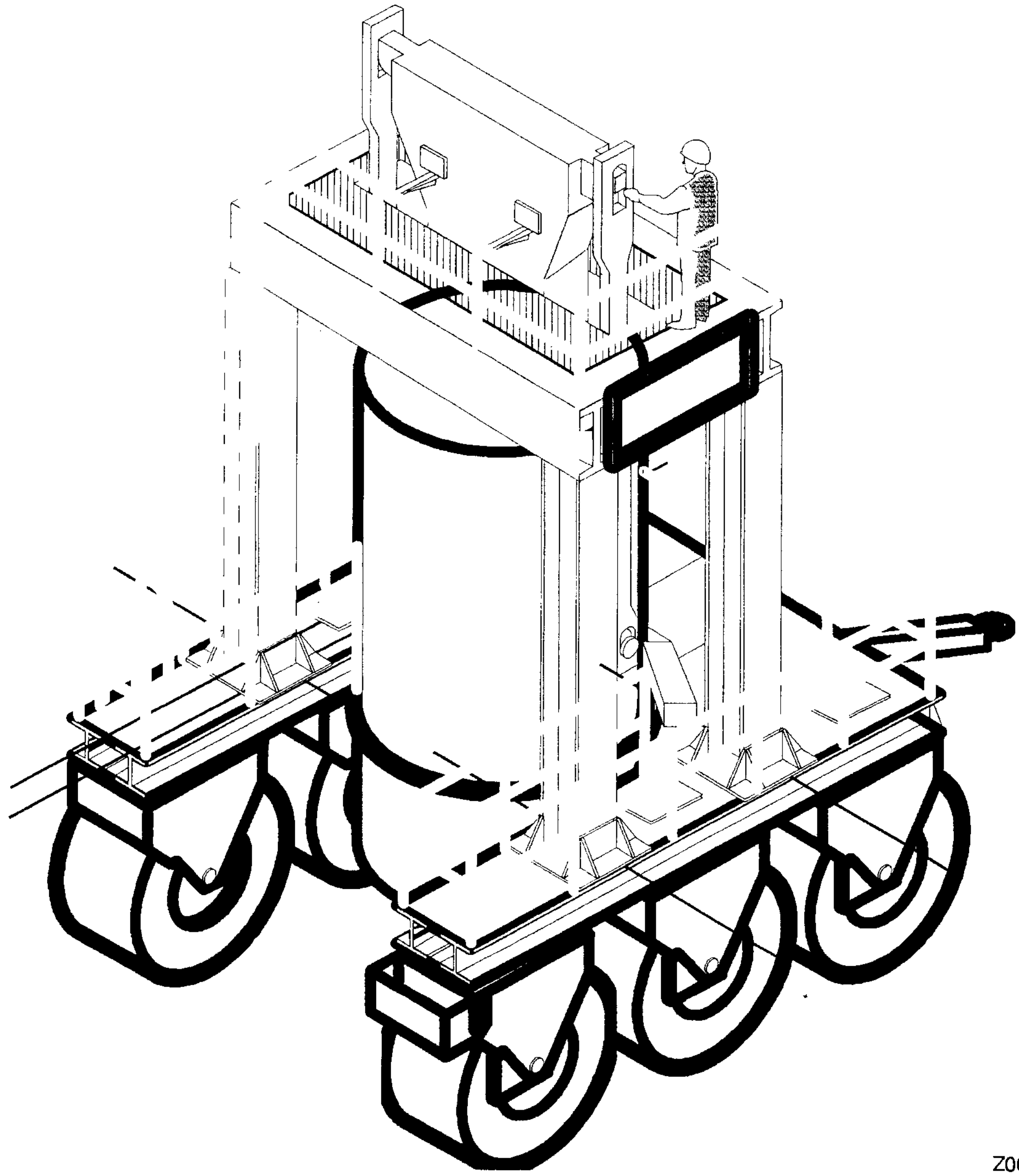

Figure 2-18. Spent fuel storage cask transporter.

support trunnions are provided on the support skid/transfer trailer. A cover plate is provided to close the bottom hydraulic ram access penetration of the cask during unloading. The OS-197 cask is carried on a transfer trailer, which weighs approximately 10 tons and has a load capacity of 125 tons. Additional information on the OS-197 Cask may be found in Reference 2-21.

2.3.10.5 TRUPACT-II

The TRUPACT-II container is used to transport (14) DOT 17C 55-gallon transuranic waste drums that have been examined and subsequently certified as acceptable for shipment to the Waste Isolation Pilot Plant (WIPP) in New Mexico. Definitions regarding the classification of mixed transuranic waste (MTW) are found in DOE G 435.1-1, "Implementation Guide for use with DOE M 435.1-1."[22] Information about the TRUPACT-II container and MTW drums can be found in SAR-4.[2-23] A detailed description and graphic representation of the TRUPACT-II container and MTW drums are located in the WIPP TRUPACT-II Authorized Methods for Payload Control (TRAMPAC) transportation document.[2-24]

A TRUPACT-II container may be placed into the Hot Shop for examination, handling, and over-packing activities. The TRUPACT-II is a reusable, double-contained, cylindrically shaped, Type B container licensed by the Nuclear Regulatory Commission to ship TRU waste. The TRUPACT-II container is designed specifically for transporting (TRU) waste from various waste generators and storage facilities at the INEEL (including RWMC) to WIPP for final disposal. TRUPACT-II containers are shipped using a tractor/trailer assembly. The fully loaded TRUPACT-II MTW cask weighs approximately 19,250 lb with a payload limit of 7,265 lbs.[2-24]

2.4 Process Description

TANO processes consist of both simple operations that occur in only one location and more complicated operations involving several areas. This section describes the processes individually, including their interfaces with other TANO areas.

2.4.1.1 Receipt, Examination, Testing, and Storage

Because the TAN Hot Shop is equipped for remote handling, it functions as a place to receive radioactive or fissile materials that need to be examined, tested, or placed in interim storage. Exposed spent nuclear fuel (unclad fuel) is not routinely handled in the TAN Hot Shop, although some damaged fuel may be received in the course of normal operations.

Receipt of any item is basically performed in the same manner. The container or cask in which the radioactive or fissile material was shipped to TAN is brought into the Hot Shop through the Heavy Equipment Cleaning Facility (HECF) on a flatbed truck or some special transporting equipment, such as the cask transporter. The container or cask is moved into place using the 110/10-ton overhead crane. Once the container or cask is in the Hot Shop, the radioactive or fissile materials can be remotely removed using the 110/10-ton overhead crane or O-man in order to examine, test, or prepare for interim storage. The 110/10-ton overhead crane and O-man are also used to move items within the Hot Shop. Accidents that may occur while manipulating various items with the 110/10-ton overhead crane or O-man are analyzed in Chapter 3.

For example, commercial reactor fuel assemblies arrive in DOE- or NRC-certified casks. The assemblies are removed from the cask with the 110/10-ton overhead crane, placed in a strong-back device, secured to prevent damage, and placed in a fuel storage rack (coffin) designed for criticality safety. The coffin is lowered into the Storage Pool vestibule and placed on the pool transfer cart using the

110/10-ton overhead crane. Placement of the coffin in the Storage Pool is accomplished using the pool transfer cart and the 15-ton bridge crane. All transfers of items to the TAN Storage Pool are performed in a similar fashion.

Other radioactive materials, such as reactor components, filter resins, and waste packaged for disposal may also be received in the TAN Hot Shop. Some of these items are brought to the TAN Hot Shop to be examined and then returned to their storage location. For example, mixed hazardous waste containers from the INEEL Mixed Waste Storage Facility (MWSF) have been examined to verify that the actual contents match the generator-indicated contents.

Various examination and testing procedures are performed in the Hot Shop along with fuel assembly superstructure removal and fuel element disassembly. Storage casks are brought into the Hot Shop periodically for maintenance and examination.

Interim storage typically occurs in the TAN Storage Pool or in storage casks placed on pads. However, items may be stored in the Hot Shop if adequate shielding and contamination control are provided so that personnel may enter for hands-on tasks, such as preventive and corrective maintenance. The North Silo, located in the Hot Shop, also provides interim storage for dry fuel assemblies. In making transfers into or out of the silo, the cover gas system is shut down if operational, and the silo lid inflatable seal is deflated. The silo lid is removed with the Hot Shop 110/10-ton overhead crane and placed on the Hot Shop floor. Transfer of materials is performed remotely with the 110/10-ton overhead crane fitted with an appropriate grappling fixture. The inside of the North Silo can be viewed from Hot Shop window J and closed circuit television cameras mounted on the silo.

When the transfer operation is completed, the silo lid is replaced and the lid seal is inflated. The silo is then backfilled with nitrogen, if required. Although the modification of the silo as a dry fuel storage facility optimizes nitrogen containment, a continuing supply of makeup gas is required because of leakage. A 5,000-gal liquid nitrogen tank located outside of the Hot Shop provides for both the initial purging and the makeup gas.

2.4.1.2 TAN Pool Stabilization Program

The Hot Shop processes associated with the TAN Pool Stabilization Program (TPSP) can be classified into two basic categories: manipulations and dewatering. The manipulations will be performed using the existing Hot Shop equipment such as the 110/10-ton overhead crane and O-man. The dewatering will be accomplished with new equipment (see Section 2.3.1.14).

The TMI canister dewatering process takes place underwater in the Storage Pool vestibule, where a TMI six-pack has been moved using the pool transfer cart. Personnel remotely connect the dewatering lines to each of the canister's inlet and outlet ports. The majority of the free water will then be forced out of the canisters with low-pressure compressed air. The contaminated water removed from the canisters will be passed through filters and ion-exchange columns for cleaning before being returned to the pool.

Once dewatering has been completed, the 110/10-ton overhead crane with the TMI canister grapple is used to remove the canisters, one at a time, from the vestibule area. The canisters are placed in an NRC-approved shipping cask and transported for interim storage .

2.4.1.3 Lead Test Assembly Tritium Producing Burnable absorber rods (TPBAR)

The Department of Energy (DOE) proposes to irradiate sealed tritium producing burnable absorber rods in commercial light water reactors. Confirmatory testing was completed and the first core load of targets were fabricated and irradiated. The design for burnable poison rods uses lithium, rather than boron, in pressurized water reactor (PWR) fuel assemblies. As a result of irradiation by neutrons in the reactor core, some of the lithium in the target rods is converted to tritium. The irradiated burnable poison rods are removed from the fuel assemblies and shipped to a DOE facility for extraction. The lead test assembly (LTA) demonstrated this irradiation process. The LTA irradiation serves as a confirmatory test of the design for tritium producing burnable absorber rods (TPBARs).[2-25] The LTA TPBAR pins have been removed from the assembly structure that was used to insert the unit into the reactor core. The TPBAR pins were then placed into a storage tube. See Figure 2-19. It is anticipated that TPBAR pins from the LTA will be received in the TAN Hot Shop in the NAC-LWT or another DOE or NRC approved transportation cask. The storage tube may be stored in the TAN Hot Shop North Silo or in the TN-24P or MC-10 casks on the Spent Fuel Testing Pad, TAN-791.

Each LTA consists of a Westinghouse hold-down assembly that supports 8 TPBARs and 16 dually compatible Westinghouse thimble plugs, as illustrated in Figures 2-20, 2-21, and 2-22. The TPBAR design is similar in form and function to a Westinghouse burnable poison rod. The

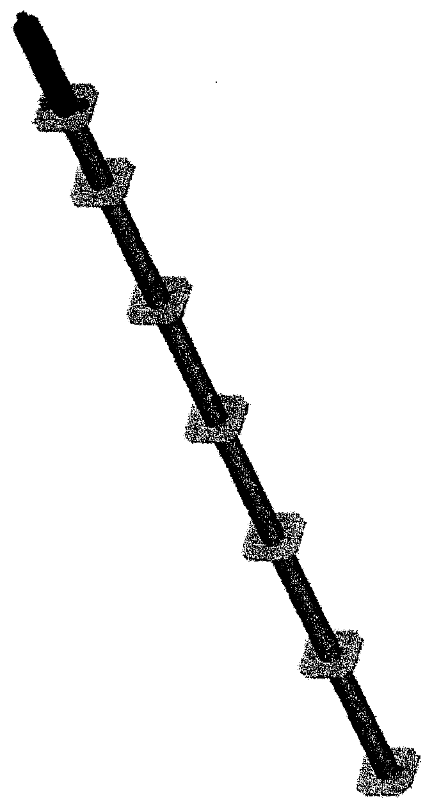

Figure 2-19. TPBAR Storage Tube.

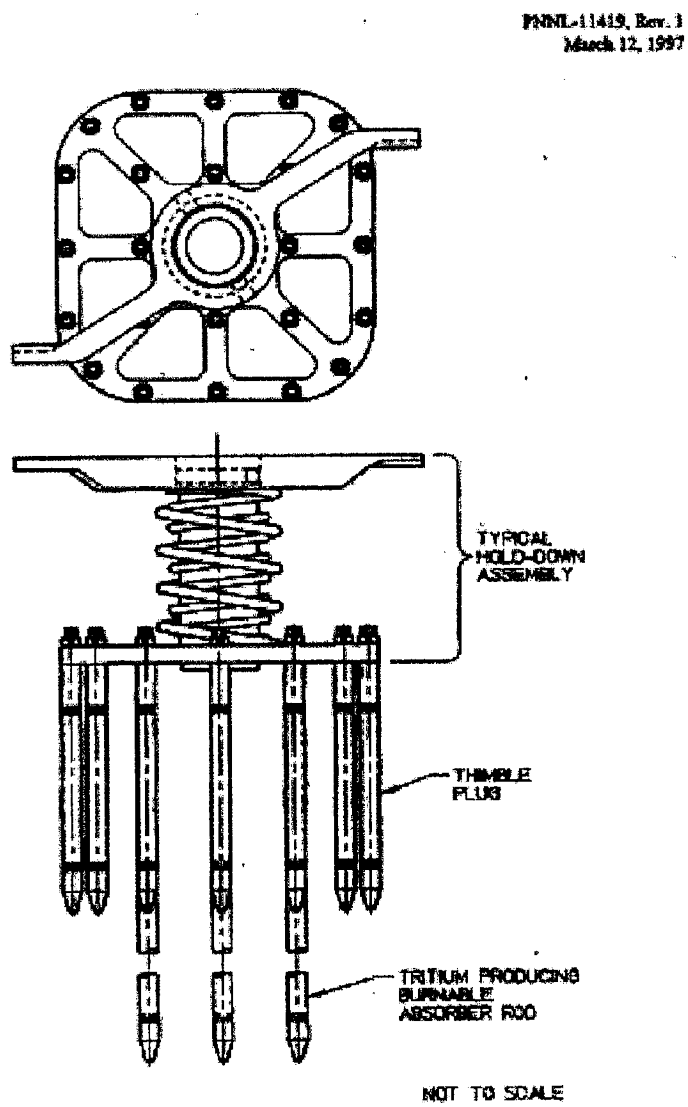

Figure 2-20. Lead Test Assembly.

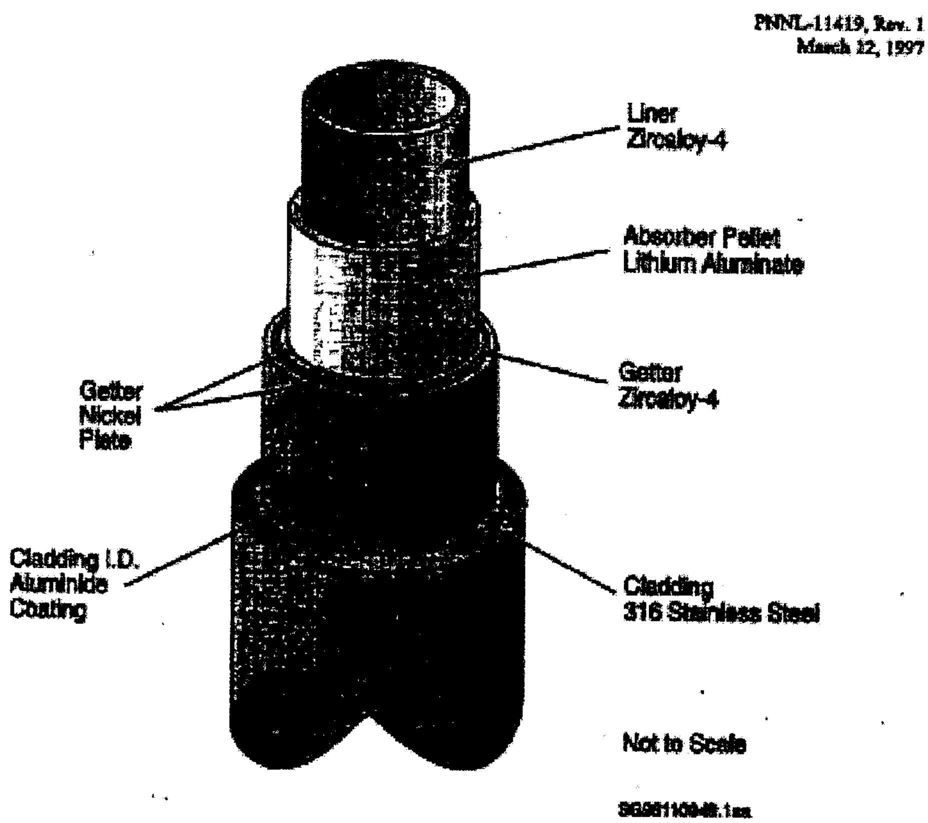

Figure 2-21. Sketch of TPBAR Components.

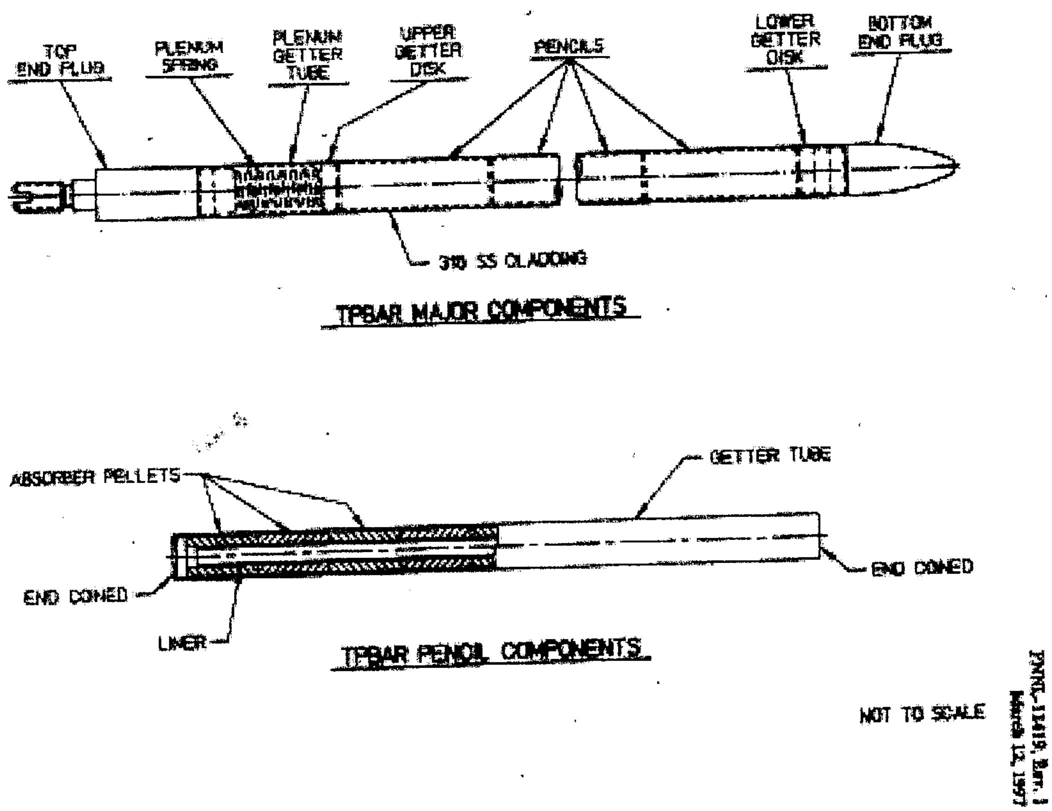

Figure 2-22. Sketch of TPBAR Components.

absorber material is in the form of annular lithium aluminate absorber pellets enriched in ^{6}Li to produce specific quantities of tritium. The TPBAR design consists of concentric cylindrical subcomponents clad with Type 316 stainless steel (316 SS). The 316 SS tubular cladding provides structural strength and is the pressure barrier between the TPBAR internals and the reactor coolant system during irradiation. The TPBAR internal subcomponents are a plenum subassembly, twelve pencils and a lower getter disk, shown in Figure 2-20. A pencil consists of Zircaloy-4 liner around which are stacked absorber pellets that are confined in a getter tube, shown in Figure 2-21. The getter tube surrounds the absorber pellets and is composed of nickel-plated Zircaloy-4. Tritium produced in the absorber pellets is released and reacts with the getter to form a solid zirconium tritide precipitate in the Zircaloy-4.[2-26] The LTA does not contain fissile material such as U-235 or Pu-238. Handling and visual examination of the LTA TPBAR pins are performed remotely in the TAN Hot Shop.

Experimental irradiation tests of tritium targets were performed in the Advanced Test Reactor (ATR) at the INEEL. The experimental data bound expected LTA irradiation conditions with regard to pellet burnup and thermal neutron fluence. Detailed test results have been documented in Reference 2-26.

Casks located at TAN-791 are proposed as an interim storage location (< 6 years) for 28 TPBAR pins irradiated in the Watts Bar Nuclear Power Station. The M-10 or TN-24 casks maybe used to store a canister containing the TPBAR pins. It is also anticipated that the TAN Hot Shop North Silo may be required as an interim storage location during transfers from the transport cask (NAC-LWT) to the interim storage cask.

2.4.2 Special Equipment Services Room

Operations in the SES room are similar to those discussed in Section 2.4.1.1 for the TAN Hot Shop. The ability to isolate the SES room from the rest of the Hot Shop by closing the shield doors allows the SES room to be used for repairing various Hot Shop equipment. This is particularly valuable for maintenance of the 110/10-ton overhead crane or O-man in situations when the rest of the Hot Shop might be in a remote condition.

2.4.3 TAN Hot Cell

The TAN Hot Cell is used to remotely perform activities, such as inspection, disassembly, cutting, testing, metallurgical sample preparation, and packaging, involving radioactive parts, sources, fuel assemblies, fuel rods, etc. These items are remotely transferred between the Hot Shop and Hot Cell using the Hot Shop/Cell transporter system (see Section 2.3.1.12). Once in the Hot Cell, the items are remotely handled using the equipment in the Hot Cell (see Section 2.3.2).

All normal operations in the Hot Cell are performed remotely, because the Hot Cell may be highly contaminated and contain high radiation levels. Remote activities also include maintenance and preliminary decontamination of contaminated equipment. Personnel can enter the Hot Cell when necessary; however, special precautions must be taken. Each entry is evaluated on a case-by-case basis.

2.4.4 TAN Storage Pool

TAN Storage Pool processes revolve around moving items between the TAN Hot Shop and Storage Pool, inspecting stored items, and maintaining water quality. Moving items follows the same basic sequence. Items are placed on the pool transfer cart using either the Hot Shop 110/10-ton overhead crane or the Storage Pool 15-ton bridge crane, depending on where the moving sequence is initiated. The items are secured on the pool transfer cart and then moved underwater within the Storage Pool and vestibule. Then, the items are lifted off of the pool transfer cart using either the Hot Shop 110/10-ton overhead crane or the Storage Pool 15-ton bridge crane, depending on where the moving sequence is completed. The 110/10-ton overhead crane or 15-ton bridge crane is used to position the items in the Hot Shop or Storage Pool, respectively.

TANO personnel visually inspect the stored items using the 15-ton bridge crane to position themselves. Also, periodic vacuuming of the items stored in the Storage Pool with an underwater vacuum system helps maintain water quality. Vacuuming is performed from the personnel platforms on the 15-ton bridge crane.

2.4.5 Hot Cell Annex

There is no future mission envisioned for the Hot Cell Annex (HCA). The Hot Cell Annex is out of service.

2.4.6 TAN Warm Shop

The TAN Warm Shop is a high-ceiling area where test assemblies with minor radioactivity or contamination can be examined, tested, or temporarily stored. Preventive and emergency maintenance of equipment, and receipt and preparation of shipping and storage casks can be performed in the Warm Shop. Also, mock-ups of jobs that are to be performed in the Hot Shop, providing hands-on training for Hot Shop operators, are prepared in the Warm Shop.

Items are brought into the Warm Shop on a vehicle, such as a flatbed truck or rail car. The items are removed from the vehicle and placed in the Warm Shop using the Warm Shop bridge crane. Once an item is positioned in the Warm Shop, the specific processes or operations are performed.

2.4.7 Radioactive Liquid Waste Storage and Transfer Building (TAN-666)

TAN-666 is designed to receive and store liquid waste generated by normal operations, cleanup activities, and accidental spills of radioactive materials inside the TAN Hot Shop, Hot Cell, and HCA. Spills that cannot be cleaned up directly are washed down drains leading through valve boxes and underground piping to TAN-666. Liquid waste can also be introduced directly from tank trucks through the liquid waste fill connection or the portable sump fill connection shown in Figure 2-11.

All liquid waste enters the 600 gal capacity surge tank by gravity flow. High and low liquid level sensors monitor the tank and display information in the RCT office. When the high liquid level sensor is activated, alarms sound in both the RCT office and in the TAN-601 guard gate. The liquid waste pump is then manually turned on and the waste is pumped through the filter units to one of the storage tanks.

Upon reaching the maximum level in the storage tanks, the waste may be pumped into an outside tank truck and sent for processing. Transfer to the truck is through an overhead pipe boom and flexible hose connection. The system is designed so that any remaining liquid drains back into the storage tanks or into the tank truck upon completion of the liquid waste transfer.

Samples of the liquid waste may be removed from either storage tank via small diameter stainless-steel sampling lines connected to sampling ports located on the east exterior wall of the tank vault adjacent to the control panel.

2.4.8 Radioactive Parts Service and Storage Area

The processes associated with the Radioactive Parts Service and Storage Area (RPSSA) are typical of warehousing operations. Material handling at the RPSSA is limited to hand-operated and mobile mechanical equipment because there are no permanently installed cranes or hoists. Items are limited in weight and size to that which can be safely handled by personnel or that are within the rated capacity of the available lifting equipment to reduce the risk of personal injury, material damage, or loss of contamination control.

2.4.9 Cask Pads

2.4.9.1 TMI-2 Abnormal Waste Storage Pad (TAN-790)

The processes associated with TAN-790 are cask transport, storage, inspection, and maintenance. Cask transport within TAN-790 and between TAN-790 and TAN-607 is accomplished using the spent fuel cask transporter (see Section 2.3.10.3). As the storage casks are positioned on the pad, gamma radiation readings are collected using a portable exposure radiation detector. Individual and collective cask readings are logged for future reference. The readings are obtained at the cask surface, 1 ft away, and 3 ft away. Also, thermoluminescent dosimeters (TLDs) are installed on the fence around the pad and analyzed to record exposure in the area.

The casks are routinely inspected during storage for any signs of deterioration or loss of containment. The inspection is performed visually using radiation detection instruments. The data collected during surveillances may be compared to initial values so that operating personnel can be alerted to cask conditions that may require action. Changing cask conditions are handled on a case-by-case basis. Expected values for the data are shown in Table 2-1.

Table 2-1. Expected data for TMI-2 abnormal waste casks.

Parameter	Expected data value
Dose rate at 0.9 m (3 ft)	Approximately 4 mrem/hr
Dose rate at interstice between four casks, maximum	Approximately 30 mrem/hr
Dose rate at perimeter fence	<5 mrem/hr

Periodic maintenance on the casks is performed at TAN-790 if possible. If not, the cask is transported to the TAN Hot Shop for maintenance and then returned to the pad.

2.4.9.2 Spent Fuel Storage Cask Testing Pad (TAN-791)

The Spent Fuel Storage Cask Testing and Storage Program consists of three phases requiring different cask configurations: (a) test phase, during which time internal gas sampling is conducted, (b) short-term storage phase, during which time spent nuclear fuel can be stored on the pad for a period of less than 5 years andfuel movement is expected, and (c) interim storage phase, during which time spent nuclear fuel is stored and no fuel movement is anticipated. This program is in the interim storage phase and cask performance data are collected as required by the project surveillance requirements. The Project Management Plan for Long-Term Storage and Monitoring addresses all surveillance and monitoring activities.[2-27]

The TAN-791 cask storage pad will also be the interim storage location for LOFT and commercial fuels and the two TMI-2 fuel canisters containing epoxied fuel, pending final disposition of these fuels. The operations associated with interim storage of these fuels being placed into dry cask storage as a part of the TAN Pool Stabilization Project are addressed in Addendums 1, 2, and 3 to this SAR.

The processes associated with TAN-791 are cask transport, storage, inspection, and maintenance. Cask transport within TAN-791 and between TAN-791 and TAN-607 is accomplished using the spent fuel cask transporter (see Section 2.3.10.3). Casks are placed in the vertical position on the testing pad without impact limiters. A minimum space of 5 ft is maintained between adjacent casks to promote heat dissipation and to allow access for surveillance and maintenance.

Routine visual inspections of the casks indicate any potential concerns, which are noted and reported to project management for evaluation. Radiation data are collected using the appropriate instrumentation. TLDs are installed on the fence around the pad, and are analyzed to record radiation levels in the area.

Cover gas samples may be taken at various times as determined by the project during the residence of a cask on the pad. A radiological work permit and monitoring by an RCT are required for gas sampling. The RCT will assess the need to use temporary enclosures, shielding, lead-lined gloves, or special tools to adequately handle the sampling train. The technicians will receive a personal survey before exiting the pad. No gas release is planned at the pad during this process.

Pressure monitoring systems are used to detect cask leakage. If leakage should become excessive, remedial measures will be taken that may include moving the cask to the TAN Hot Shop. When the cover gas must be replenished, the trace gas cylinder fittings will be connected to the cover gas sampling valves on the cask. Sufficient gas mixture is added to elevate the cover gas pressure to specified limits.

Data collected during surveillance of the spent nuclear fuel storage casks will be compared to expected values so that the project manager can alert operating personnel to cask conditions that may require action. Changing cask conditions will be handled on a case-by-case basis.

2.5 Confinement Systems

The confinement systems used throughout TANO are a combination of physical confinement and maintaining negative pressure. As discussed earlier in this chapter, physical structures such as walls, windows, and doors provide shielding from radiation and confinement for radioactive contamination. In addition to these physical structures, there are ventilation systems, which maintain negative pressure, and HEPA filter systems.

2.5.1 Ventilation System Descriptions

No special ventilation is provided in the TAN-666 tank or pump vaults. Entry into either vault is controlled in accordance with Company procedures on confined spaces and oxygen-deficient atmospheres. Auxiliary ventilation required for entry requires HEPA exhaust filters if the level of airborne activity concentrations exceed the maximum permissible concentrations listed in 10 CFR 835 and the *INEEL Radiological Control Manual.*

Also, there are no special ventilation systems provided for storage buildings TAN-647 and TAN-648, because items stored in theses buildings only have fixed contamination on them. There are 372,000 g of depleted uranium stored in TAN-647, but there is no fissile material in either building.

2.5.1.1 TAN Hot Shop/SES Room System

During normal operation, air is continuously supplied by supply fan S6, exhausted through separate prefilters and HEPA filters by exhaust fan E7A or E7, and then discharged out the TAN stack. A fan speed control system on supply fans E7 (manual control) and E7A (automatic control) compensates for changes in Hot Shop/SES room negative pressure by speeding up the fan as the negative pressure decreases. Exhaust fans E7 and E7A are redundant, with E7A running during normal operations; exhaust fan E7 is on standby power. If all fans are shut off, air infiltrates into the TAN Hot Shop and SES room because of a natural draft created by the TAN stack.

2.5.1.2 TAN Hot Cell System

The Hot Cell is maintained at a negative pressure with respect to the Hot Shop atmosphere. Air drawn from the general building area enters the cell through the manipulator ports and other penetrations, and is exhausted through a roughing filter bank. The air is then ducted to the fan room, filtered through a second and third bank of HEPA filters (one of which is tested), and then released through the TAN Hot Shop stack. The Hot Cell air is moved by exhaust blower E8, with fans E7A and E7 as backup. If fan E8 fails, a gravity damper opens and cross-ties the Hot Cell to the E7A/E7 system. A damper duct arrangement allows manual control of fan E7 in the event that fan E8 is out of service.

2.5.1.3 Hot Cell Annex System

Supply air is provided for all four cells of the HCA through infiltration from the setup area and operating gallery, through cell penetrations and manipulator holes, and around shielding doors. Fans E4A and E4 provide exhaust from all four cells. Because of the intercell transfer drawers, the four cells tend to act somewhat as a unit with respect to cell pressure. However, air flow, regulated by dampers, is generally from the least contaminated cell (Cell 4) to the most contaminated cell (Cell 1). The air flow out of the cells is through prefilters located in each cell and a HEPA filter bank. If cell negative pressure tends toward zero due to filter plugging or cell opening, a variable inlet vane on E4 may be opened or the E4A speed will increase automatically to maintain proper flow. The exhaust air is discharged through the Hot Shop stack.

2.5.2 General System Information

In the event of a loss of commercial electrical power to the exhaust fans for the TAN Hot Shop/SES room, Hot Cell, or HCA, electrical power is automatically switched over to the standby diesel generator, which will operate until the commercial supply is restored.

Air flow through the Hot Shop stack (TAN-734) is sampled continuously for radioactive contaminants. The readout and local alarm for flow are located in the stack room. A remote alarm and readout are located in the RCT office. The stack monitor system is on standby power.

If a HEPA filter fails while in service, the Hot Shop stack sample filters will collect any higher-than-normal levels of radioactivity in the exhaust air. Any alarm of the stack monitoring system is verified and appropriate action is taken per the *TANO Operating and Maintenance Manual*.

2.6 Safety Support Systems

This subsection identifies and describes the principal systems that perform safety support functions.

2.6.1 Fire Protection System

Fire protection within TANO is accomplished by a combination of (a) observation by operating personnel, (b) fire suppression systems (both automatic and manual), and (c) activation of fire alarms. The fire mitigation systems within TANO for each of the buildings and areas that could contain radiological inventories are as follows:

2.6.1.1 General fire protection systems

All of the automatic sprinkler systems and the deluge systems are tied into the alarm system and the TAN local emergency notification alarm system. When activated, they will alarm at the fire stations and an announcement will be made to the TAN area. INEEL Fire Station No. 3 is operated full-time and is located approximately one-half mile south of TAN-607, outside the TAN fenced area. TANO also has a trained incident response team, who can take the appropriate mitigative actions until fire department personnel arrive.

Water for the fire sprinkler and deluge systems is provided by the TAN-TSF firewater distribution system. Water is stored in a 500,000-gal tank and two 1,000 gpm electric automatic fire pumps, operating at 100 psi. The pumps take suction from the storage tank to supply the fire main system. The storage tanks are supplied from deep wells at TAN. A 1,500 gpm, diesel-driven fire pump provides water pressure if commercial electrical power is lost.

2.6.1.2 TAN-607 fire protection systems

Automatic wet-pipe sprinkler systems protect all areas of TAN-607 except the TAN Hot Shop/SES room, TAN Storage Pool, TAN Hot Cell, hot cells in the HCA, and Hot Shop north gallery.

The Hot Shop and SES room are protected by a manually operated deluge-type fire sprinkler system and portable fire extinguishers. The deluge system is composed of four zones, each controlled by a deluge valve. Three deluge zones cover the Hot Shop and one deluge zone covers the SES room. Each zone is designed to provide 0.25 gpm/ft^2. Fire detection is by flame detectors with remote alarms and by visual observation. The three manually operated deluge valves for the Hot Shop are located in the south operating gallery. The deluge valve for the SES room is in Room 220.

To reset the deluge system, the manual shut-off valves must be closed and the riser piping must be drained. The 8 in. control valve in the main supply line located in the Warm Shop is supervised by a tamper switch that sends a trouble alarm to INEEL Fire Station No. 3 if the valve is closed.

The TAN Hot Cell is protected by two fire protection systems: (a) a manually operated, total flooding carbon-dioxide system, and (b) a combination dry-chemical/dry-powder system. The Hot Cell operating gallery (Room 110) and access area (Room 107) are protected by wet-pipe automated sprinklers and portable extinguishers. Each discharge nozzle has a restricted orifice to prevent overpressurization. Two actuators for the carbon-dioxide system (one for the main and another for the reserve banks) are located side by side on the south wall of the Hot Cell operating gallery. The CO_2 system has been removed from service pending resolution of personnel health and safety concerns during maintenance in the hot cells.

The dry-chemical system, consisting of separate tanks of ABC dry chemical (for all fires other than combustible metal fires) and dry powder (for pyrophoric metal fires only) extinguishing agents can be activated from pull stations above window P or window R. The extinguishing agents are piped through a common manifold that penetrates the cell wall to a discharge hose in the cell. The master-slave manipulators are used to direct the application hose and apply the agent on the fire.

Fire protection for the TAN Storage Pool area consists of hand-held extinguishers: one carbon-dioxide extinguisher located in the southeast corner of the room, and two multipurpose dry-chemical fire extinguishers (one in the southwest corner and one in the northwest corner). Other portable extinguishers can be brought from adjacent areas, less than 50 ft away.

2.6.1.3 TAN-647 and TAN-648 Systems

TAN-647 and TAN-648 are protected by an automatic detection and dry-pipe sprinkler system. When either of these systems are activated, alarms annunciate in the TAN gatehouse and at the INEEL Fire Department. In addition, there is a portable ABC fire extinguisher located outside the north personnel door of each building.

2.6.1.4 TAN-666 systems

Fire protection for TAN-666 consists only of hand-held fire extinguishers mounted in and around the building.

2.6.2 Breathing Air System

The TAN Hot Shop is equipped with a breathing air system that complies with American National Standards Institute (ANSI) Z88.2, "Practices for Respiratory Protection," consisting of a compressor, air purifier, air storage tank (located in Room 112), and 13 supply stations. The system is designed to provide 150 cfm of air at 100 psi, enough for five people. The air purifier consists of a particulate filter, carbon absorbers, a catalyst vessel to convert carbon monoxide to carbon dioxide, and a moisture separator. Each breathing air station is equipped with a pressure regulator, Mine Safety Appliance breathing air filter, and four-receptacle manifold using 0.5-in. quick connect/disconnect valves. A station is located on pedestals A, B, C, F, H, and L within the Hot Shop. Two stations are located in the SES room, two at the Hot Shop labyrinth, and three in the gallery and work areas surrounding the Hot Cell. The system contains alarms located on the gallery control panel: high temperature, low pressure, high pressure, and breathing air trouble.

2.6.3 Radiation Monitoring

The radiation monitoring system is an integrated system composed of the stack monitor, continuous air monitors (CAMs), and RAMs, which alarm locally and, in some cases, remotely. Readouts from the stack monitor and the RAMs are transmitted to the TAN-607 RCT office. The setpoints for the various equipment in the radiation monitoring system (stack monitor, CAMs, and RAMs) are set by the RCTs and vary depending on the TANO activities being performed. The radiation monitoring system is powered from the standby section of the motor control center, which automatically picks up power from the standby diesel generator when commercial power is lost.

Exhaust air streams from the TAN Hot Shop and Hot Cell are exhausted up a common 150 ft high stack (TAN-734). The air is sampled continuously for radioactive particulate contaminants through an isokinetic side stream sampling loop. The multi-port probe samples the entire diameter of the stack and meets the requirements of ANSI13.1-1969. The emission gas is sampled isokinetically with 50% of the 10-micron particles reaching the filter housing. The radioactive emissions are monitored and recorded in accordance with 40 CFR 61.93 paragraph (b) and 40 CFR Subpart A.

The monitor consists of the sample probe that sends pressure drop and temperature signals to the controller to determine the stack and sample line velocity in SCFM. The controller adjusts the sample line control valve to maintain isokinetic flow of the sample stream. A signal representing both velocities is sent to strip recorders located in the Radcon control room 120. A vacuum pump is used to provide the sample line flow through the sample line, the filter housing section, and back into the stack. The filter housing holds the 47mm filter papers and has a space for a cartridge to sample gases if wanted.

During normal operation the stack and sample flows are checked daily to verify proper system operation. Changes in stack flow should cause a proportional change in sample flow to maintain isokinetic gas sampling. For example, a stack flow reading of 9,750 SCFM (75% of stack full scale) should produce a sample flow of 3 SCFM (75% of sample full scale). Note: stack full-scale flow is 13,000 SCFM and sample full-scale flow is 4 SCFM.

The TAN-734 stack gas filters are changed weekly and stored in the TAN 607 RCT lab and a screening count completed for the previous week's filter. The results of the count are used to calculate the airborne activity. At least quarterly, the collected filters are sent to the Radiation Measurement Lab (RML) at the Test Reactor Area for analysis. The RML enters the analysis data into the Radioactive Waste Management System database for NESHAPS permit reporting.

Emergency actions in the event of an accident must be based on local measurements (RAMs, CAMs, and portable instruments).

CAMs are also used throughout TANO to indicate airborne radioactivity. The placement of these CAMs is based on the guidelines provided in the *INEEL Radiological Control Manual*.

The RAM system consists of a network of strategically located low-range and high-range radiation detectors that warn of potential high radiation fields. The monitors are located near potential sources of radiation and in areas where a buildup of radioactive material may result in excessively high radiation levels. Low-range detectors may be located in the operating areas associated with the Hot Shop, Hot Cell, and Storage Pool. The high-range detectors are located in the Hot Shop and SES room, and have readouts at the appropriate window operating stations. Some Hot Shop RAMs have portable heads and can be repositioned remotely within a 50 ft radius using manipulators.

The RAMs monitor the gamma-radiation levels, and the signal from the detector is transmitted to the RCT office. The RAMs can be set at variable alert and high-level setpoints, depending on the scheduled work in the respective areas. If a setpoint is exceeded, alarms, including system failure status alarms, are transmitted to the RCT office and displayed on the annunciator panel. An audible alarm is sounded in the general vicinity of a RAM initiating an alarm signal. The system is designed so that chamber saturation from a high-radiation level will not cause the loss of an alarm signal.

2.7 Utility Distribution Systems

TAN receives its electrical power from the INEEL Site Power System. The INEEL Site Power System comprises 65 mi of 138-kV transmission line with 1,082 associated support structures, 1,716,000 ft of conductor cable, many miles of secondary voltage feeder lines, 122.6 MVA (megavolt amperes) of transformer capacity, and seven major substations. One substation, Scoville, is the point at which offsite power is fed to the INEEL and delivered to the east and west buses, energizing the site power loop, which then supplies power to the other six substations, one of which serves the TAN area.

Power to the Scoville substation (and, hence, the INEEL) is provided via two transmission lines from Utah Power and Light Company's (UP&L) Antelope substation, which in turn receives power from feeders provided by UP&L, the Idaho Power Company, and the Montana Power Company.

A diesel generator provides the backup power supply for all essential equipment needed within TANO. The 900-kW generator is connected to the appropriate electrical buses through an automatic transfer switch. In the event of commercial power failure, these buses will be automatically switched to the diesel generator supply. When commercial power is restored, the buses will automatically return to that supply.

In the event that all electrical power is lost, emergency lighting in the operating areas is provided by wall-mounted, battery-powered emergency lights. Similar emergency lighting is not available in the Hot Cell or HCA cells. Provisions for portable emergency lighting for safe egress from these areas are administratively controlled.

No permanently installed ground fault interrupter protected circuits are available in any of the cells for powering portable hand tools. All portable electric tools used in the TAN Hot Cell complex shall be of double-insulated construction or have ground fault protection. Use of hand tools will be administratively controlled to ensure compliance with this requirement.

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